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Bureau of Mines Policies Emphasize Economic Studies

HIS APPOINTMENT as Director of the Bureau of Mines having been confirmed by the Senate on January 21, Dr. John W. Finch subsequently announced some of his plans and policies for the service of the Bureau to the mining industry. As foreshadowed in his own appointment and in his selection of J. W. Furness to head the Economics Branch of the Bureau, immediate emphasis will be placed on economic studies of the mineral industries, though not, of course, excluding attention to technology, safety, and other activities.

The decision is wisely in accord with the times. It would be the part of wisdom at any time not to neglect economic studies; but in the current period of recovery they are exceptionally important in guiding the mining industry back to a sound basis of profitable operation. Recent mining history bears ample testimony not only to the need of complete economic and statistical data, but also to the necessity of interpreting and using them.

Service to the Government's recovery program as well as to the mining industry is inherent in Dr. Finch's plan. If the Government is to adopt a national policy to conserve mineral resources and rehabilitate the mining industry, as recommended by the Planning Committee for Mineral Policy and outlined in our January number, the Bureau of Mines should, perforce, be the federal agency to assemble the data necessary for wise administration. If the mining industry is to be permitted and encouraged to adjust production to consumption, based on forecasts of demand, an independent and impartial agency like the Bureau must gather much more complete statistics on production, stocks, consumption, costs, and secondary metals than have hitherto been available. And not with respect to domestic affairs only, but also with due regard to international conditions. Hence the sound reasoning behind the Bureau's emphasis on economic matters as an aid to long-range planning.

Technological studies will not be neglected in the Bureau's program. Greater efficiency and economy in mining and metallurgical methods must be the constant aim of the industry if profitable operation is to ensue in a period of low metal prices and world-wide competition. In such a situation the Bureau's technologists can be of great service in developing vigorous research programs and is cooperating with other research agencies that may develop ideas which the Bureau can promote in the best interests of the industry.

Federal support of the Bureau has been declining for several years past, resulting in the curtailment of vital activities and some of the services required by law. It is inconceivable that appropriations have not reached their lowest ebb. There is no way for them to go but up if the Bureau is to meet its responsibilities. Not only is more generous support warranted in view of the great service that the Bureau can and will be expected to render to the Government itself, as well as to the mining industry, but funds must be provided if the ambitious program of conservation and rehabilitation is to be carried forward successfully.

Foreign Copper Control

COPPER PRODUCTION and consumption outside of the United States during 1934 made an excellent showing, quantitatively speaking, but earnings of producers suffered because of unremunerative prices. The movement now on foot to rationalize copper in the foreign field has for its objective a more profitable market, to which producers are justly entitled.

The question before the industry is: How can this objective best be attained? Producers have learned much from past experiences; and with such control schemes as "Blue Eagle" copper, the late Zinc Cartel, and the tin-control plan in mind, there is hope that nothing will be attempted that may place copper in a bad light.

The tin-control plan, with its restriction of output and pool operations, seems to appeal most to those sponsoring the proposal for regulating the foreign copper market. The scheme is being regarded with favor, notwithstanding the fact that tin consumers are anything but satisfied with the plan. Too much price control in the interest of the producer, they say.

All agree, however, that foreign copper is in a sad plight. Even the Northern Rhodesian producers have publicly expressed a willingness to enter into a sound international copper program. Unfortunately, what appears to be perfectly sound to one group is not regarded as desirable by others. There is talk of a copper pool for marketing the output, but no one wants to hold any part of the bag. British and Canadian producers lean strongly to production control, leaving the price to take care of itself. Chilean producers and Katanga favor production control plus a comprehensive marketing plan. United States producers of copper will be asked to limit their exports. Germany and Japan want low-priced copper and have a steady eye trained on scrap developments.

Stockholders have been heard from in Great Britain, and some factions in the market are disposed to make much of this incident. Those directly concerned have reminded stockholders that the question of rationalization needs careful and diplomatic handling.

Signs are not lacking that a quick decision on copper control is not likely to be made, which in itself is a healthy indication. The questions to be weighed and settled are many and more complex than at any other time in the history of the copper industry. Negotiators will be called upon to consider currency depreciation; tariffs; import restrictions, as in Germany and Italy; political pressure; byproduct copper; employment; and, not to be put aside lightly, constant pressure in important outlets of competitive metals. The world needs raw materials at the right price.

A New Procedure in the Solution Of Mining Problems

IN THAT SECTION of its recent report to the National Resources Board entitled "The Scientific and Engineering Approach to Conservation," the Planning Committee for Mineral Policy called attention to the economic necessity for constant improvement in the technique of mining. Furthermore, it pointed out the value of impartial scientific and technological research from the viewpoint of conserving mineral resources and increasing efficiency with due regard to betterment of safety and health conditions. On the basis of these pronouncements, additional importance attaches to results achieved in the course of investigations in progress at Columbia University under the supervision of Professor P. B. Bucky. The work, which is sponsored by the American Institute of Mining and Metallurgical Engineers and supported by the Engineering Foundation, has provided fundamental data that promise additional economies in mineral production and increased safety in mining operations. A description of this research endeavor will be presented in a series of three articles in *Engineering and Mining Journal,* the first appearing in this issue under the title "Mechanics and Mining."

This first article shows that the known laws of mechanics are susceptible to direct application in mining. Such an approach to the solution of problems arising in underground mining marks a new and improved procedure for those responsible for the efficiency and safety of ore-extraction operations. This fact will become increasingly apparent as publication of the series proceeds. For the moment, suffice it to say that information made available by the investigations has already been successfully applied in actual practice. The interest that a number of executives of leading mining companies in this country and elsewhere have taken in the work is also significant and encouraging.

Vertical Casting of Copper At Carteret

B. H. Strom
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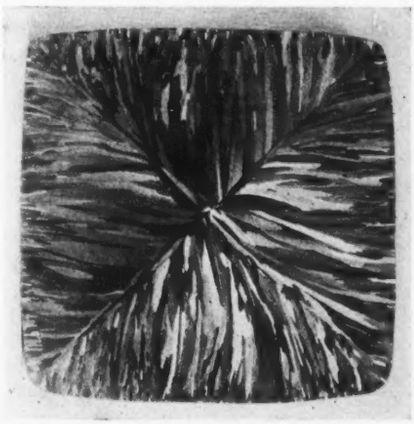
ALTHOUGH without material effect upon the inherent purity of the metal, the new procedure offers distinct advantages to the fabricator, such as a reduction of the set, oxidized surface to a minimum, and the production of shapes more easily handled in the rolling mill than are other types. The author describes some of the difficulties overcome during more than five years of development at the plant, before commercial production became a success.

COPPER REFINERS have long been aware of the fact that the casting of copper in horizontal open molds is not the ideal method of handling a metal which is to be rolled into sheets and strips, particularly where a high polish or a plate finish is called for. It is common knowledge that the wrinkled, irregular surface caused by the set, the high cuprous oxide content of this surface, and the possibility of a certain porosity immediately under the set are all factors which may lead to imperfections in the finished sheets, such as scale marks, blisters, and even oxide inclusions. To produce a polishable sheet copper, particularly where both sides of the sheet must be perfect, the set surface of the cake is frequently scalped, often to considerable depth, an expensive and time-consuming operation, resulting in excessive production of scrap for remelting.

To overcome this disadvantage of horizontally cast cakes the so-called wedge cake was introduced, a cake cast edgewise to reduce the area of the set surface. This procedure insures two smooth sides for rolling, but in order to discharge these cakes from the mold they are made with a decided taper, sufficient to make the cake drop freely when the mold is inverted; hence the name.

Fig. 1—Cross-section of 4x4-in. vertical wirebar, showing plainly the distinct diagonal arrangement of the copper crystals



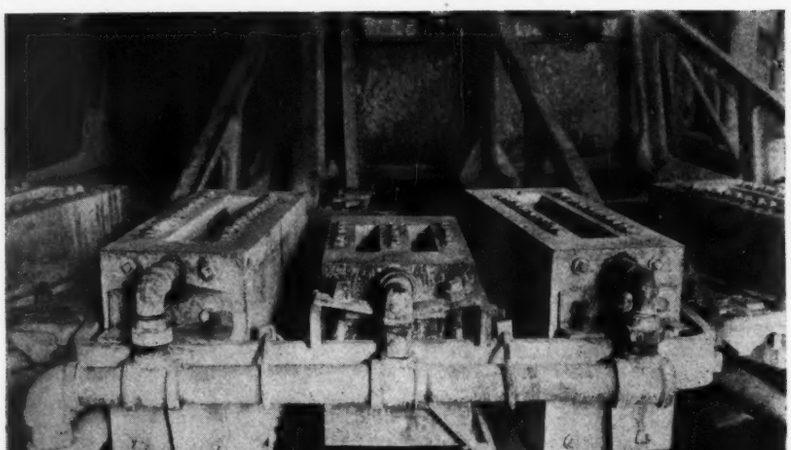
Although superior to horizontally cast cakes, the wedge cake still has some shortcomings. In rolling a wedge-shaped cake preliminary passes in the transverse direction are required to flatten it to a condition where effectual reductions may be achieved. But even with such a procedure, irregular shaped slabs or extra long "ears" on the finished material are obtained, either of which makes necessary excessive trimming, with resulting high production of scrap.

A little over five years ago experiments were started at the Carteret copper refinery of United States Metals Refining Company to develop a method which would permit the production of vertically cast shapes; that is, shapes the depth of which would be greater than either the thickness or the width, thereby confining the set surface to the end having the smallest dimension, and which at the same time would have parallel sides. The contention of the engineers attacking the problem was that no trouble would be experienced in ejecting the shapes from a mold with parallel sides if the mold were properly designed and equipped for ample water cooling, to insure rapid and sufficient shrinkage of the cast metal. The soundness of this idea was soon proved definitely.

Without detracting in any manner from the contributions made by other members of the refinery staff, special mention must be made of William F. Eppensteiner, mechanical superintendent; Henry M. Green, former refinery superintendent; and John Groom, casting superintendent, all of whom are largely responsible for taking the initiative in attacking the problem as well as for its successful solution. By a happy coincidence a fitting conclusion was thus furnished to Mr. Green's professional career, when he recently retired after more than 25 years' continuous work in the copper-refining industry.

The first mold used in the tests was fashioned by bending a sheet of steel into the desired shape, welding the ends together, and straightening the inner surface in as nearly perfect a manner as possible. A second sheet of steel was then bent around this form and welded to shape, and spiral passages for the cooling water were provided between the two sheets. A number of cakes, 4⅜x 9x21 in., weighing about 275 lb., were made in this mold. However, the mold soon warped out of shape, causing the cakes to stick, and resulting in a poor surface.

To impart stiffness and durability to the inner walls the next set of molds was made from blocks of steel in which the mold cavities were formed by drilling and cutting, followed by machining to produce a smooth surface. Water for cooling was circulated through vertical holes drilled around the cavity. A swinging gate was used to close the bottom opening during the pouring and to hold the cake in the mold until it was ready to be ejected; the gate was then sprung, allowing the cake to fall out of the mold. This arrangement gave sufficient shrinkage to permit easy discharge of the cake through the bottom, and the cakes were of an excellent quality, giving complete satisfaction in rolling tests by one of the leading mills. However, these molds were expensive to make, they began to develop heat checks, and they also showed some tendency to warp, making



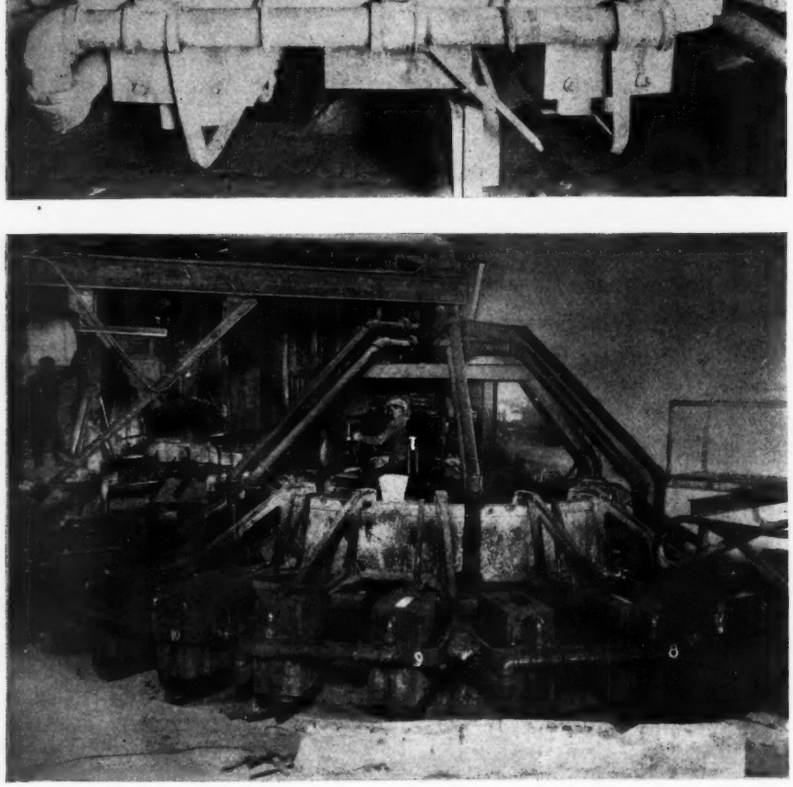


Fig. 2—Upper cut: Arrangement of single and double cake molds on casting wheel. The bale of the double mold has been released, allowing the hinged bottom door to drop into the discharging position

Fig. 3—Lower cut: Casting wheel equipped with single vertical molds for 600-lb. cakes. The hot copper is plainly visible in two of the molds in the foreground. (See the front cover)

replacement costs excessive. It was therefore finally decided to start experimental work with water-cooled copper molds.

The first copper molds were made by casting solid blocks of copper, 17½x22x36 in., in a frame mold; a large piece was sawed off the top and the center cavity was drilled, cut, and machined to form a 275-lb. cake mold, around which holes were drilled out for the water-cooling system. This was also a costly operation, but the cakes cast in these molds proved highly satisfactory. Results obtained with the cakes in rolling mills were so encouraging that it seemed urgent to attempt larger-size castings, and a few molds for 400- and 600-lb. cakes were drilled out and machined. Although equally good results were obtained in these larger molds, it soon became evident that this method of mold manufacture was too expensive and that a cheaper method of production was essential to insure economic success.

Attempts were therefore made to produce the molds by core-casting, with a center core in the mold corresponding approximately to the size and shape of the cavity desired, thus leaving only a minimum of metal to be removed by machining. After many unsuccessful trials a type of core was finally developed which could be easily ejected from the mold after solidification of the copper, and the question of mold manufacture thence no longer constituted a problem. The present type of mold is proving extremely satisfactory, the life generally averaging 1,500 casts, with the 2,000 mark a common occurrence.

An arrangement of one double mold and several single molds in position on the casting wheel is presented in Fig. 2. The hinged bottom door of the double mold has been swung open, in the discharging position; the others are closed. This door is made of cast copper and is fastened securely in a steel frame. It is so constructed that it may be held perfectly tight against the mold bottom by a bale designed for that purpose. At the top of the molds may be seen the lugs which plug the 1-in. water ducts. The cooling water enters the mold at the bottom, on the side closest to the center of the wheel, and is taken out at the top, on the opposite side.

With the successful solution of the mold construction the Walker wheel on casting furnace No. 6 was redesigned and conditioned to run with a full set of vertical molds. This furnace has a capacity of about 425,000 lb. of copper. With the exception of such poling as is required to maintain the copper at the proper pitch to accommodate the different types of cakes, large or small, no special precautions have to be taken in the operation of the furnace itself, which is perfectly regular.

Fig. 3 shows the wheel fully equipped with cake molds; the distribution of the cooling water may be clearly seen in this illustration, with the main ducts to and from the storage tank carried on a horizontal overhead steel beam, and the smaller distributing pipes running radially from the center of the wheel to the molds at the periphery. An illustration of the method of introducing the metal into the molds is presented in Fig. 4.

The molds are mounted on the wheel in pairs and two molds are filled simultaneously from a casting ladle equipped with two spouts. Pouring is done with the wheel stationary. Cakes weighing up to about 1,000 lb. are cast on the wheel. After casting, the molds travel an arc of 280 deg. to the bosh, where the bale is released with a bar, the hinged bottom door dropped free, and the cake discharged in the bosh, where it is picked up by the conveyor as shown in Fig. 5. From this point it is delivered to inspection tables.

No difficulties are experienced in dropping the cakes from the molds, save in exceptional cases of leaks or accidental disturbances, and no hammering is necessary to help it along. The mold itself is held at a reasonably constant temperature, thus maintaining the mold cavity at a constant cross-section, and the copper castings cool quickly and shrink rapidly to an extent that on reaching the position over the bosh the parallel-sided shapes drop from the molds without any hold-up. This is the basis for the success of the process.

After release of the cake the mold is inspected and given the regular wash with bone-ash solution, after which the bottom door is swung back in position and the bale is adjusted to a tight fit; this operation is by hand.

For larger sizes and shapes this procedure has had to be modified, as the depth of the wheel pit is not sufficient to allow direct tapping from the furnace into a mold of greater height than about 36 in. The floor of the casting building is only slightly above sea level, and the wheel pits cannot be made any deeper without danger of becoming flooded during high tide. The metallurgist invariably has to adapt at least some of his old equipment to new procedures, with resulting compromises and makeshifts which never represent the ideal arrangement from a technical point of view.

In this case it was found necessary to cast the larger shapes from a holding furnace. Six such furnaces are in use, cylindrical steel shells lined with firebrick and equipped with a single oil burner to keep the temperature of the metal at the desired point during tapping. They may be filled from any furnace in the casting building, and are handled to and from the wheel by the overhead crane, for which reason their size is limited to about 5 tons. Tapping is done by turning the holding furnace with a hand-operated wheel, and it discharges into the molds through a casting ladle equipped with a single spout. Adjustment of the pitch of the copper, if necessary, is accomplished by poling, directly in the holding furnace.

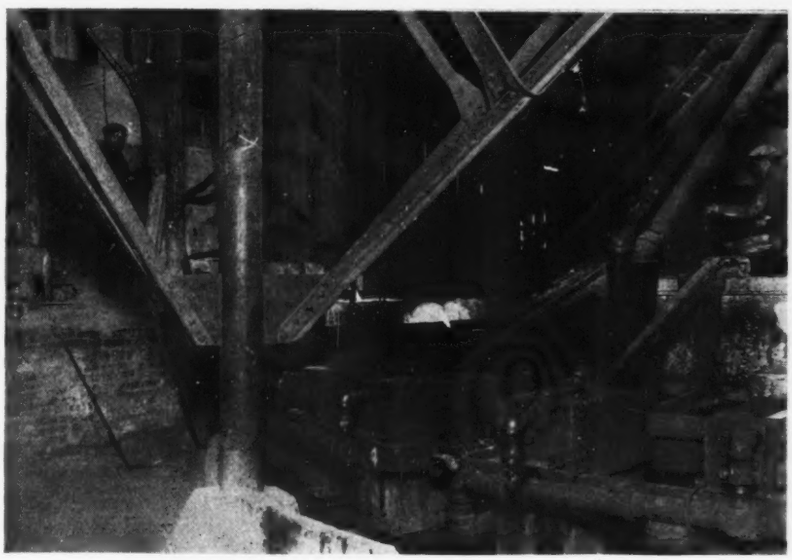
The question of maintaining the proper temperature of the cooling water has been found to be of the greatest importance. During the early stages of the work sweat warts sometimes developed on the surface of the cakes, which caused some cracking in the rolls. This was remedied by a more definite control of the casting technique. A 10,000-gal. storage tank has been placed near the furnace, and the water is circulated through the molds at a pressure of about 22 lb. per square inch. Rapid circulation is essential for good results, as the difference in the temperature of the ingoing and the outgoing water should be only a few degrees. The rate of circulation for 600-lb. cakes, for instance, is about 12.5 cu.ft. per minute per mold. The temperature of the water, which should be about 200 deg. F., is maintained fairly constant by an automatic regulating device in the storage tank, steam being admitted into the tank when the temperature is too low, and cold water when it becomes too high.

Careful control of the temperature of the copper during tapping is also an important feature. When the molds are filled directly from the big furnace this is not so difficult to maintain, as the fluctuations are quite small. In the holding furnaces, however, readings have to be taken at frequent intervals during tapping. A Leeds and Northrup optical pyrometer has been found to give good service for this purpose; a tapping temperature of 2,040 deg. F., as read by this instrument, is considered most satisfactory.

Any shape within reason may be produced by vertical casting, from the 100-lb. bottom doors used for the molds themselves to 20x20x66-in. cakes, weighing 8,000 lb., of the same size as ordinary steel ingots. These large shapes have been rolled without any difficulty, finishing with strips 6 in. wide and 0.091 in. thick. The heaviest cake cast on the wheel is about 1,000 lb.; larger sizes are cast in stationary molds. A special type of casting, as large as 10,000 lb., is also being made. These castings are being used as mold stools in the casting of steel ingots, a new and interesting application for copper.

Vertically cast wirebars have to be trimmed at top and bottom before use, about 2 in. at the top and 4 in. at the bottom, making a total of about 5 per cent scrap to be remelted. These wirebars are used to advantage in rolling trolley wire and flat sections for electrical purposes, such as transformer coils, and in cases where ordinary wirebars have to be machined prior to rolling to remove the surface of the set and other irregularities. A list of the different shapes cast at the Carteret plant at present is given in Table I. (See p. 62.)

With the carefully machined inner surface of the vertical molds a paper-like smoothness of the finished shapes



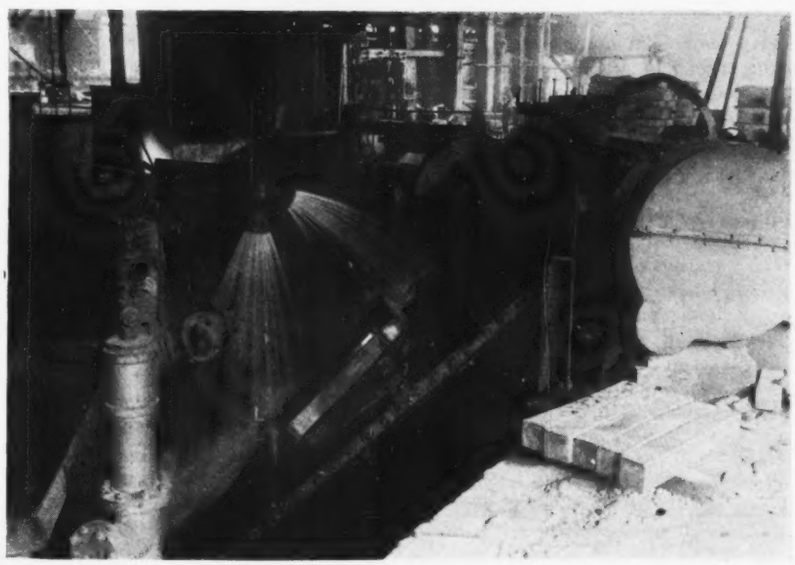


Fig. 4—Upper cut: Tapping from refining furnace through single-spout casting ladle. Wheel remains stationary during the filling of the mold

Fig. 5—Lower cut: Cast shapes taken from the bosh by conveyor and delivered to the inspection table

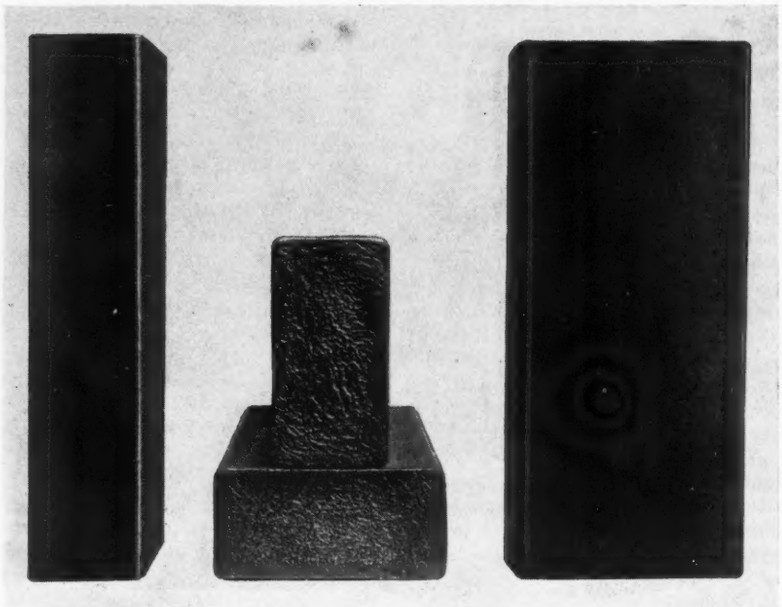


Fig. 6—Samples showing smooth surface and set of vertically cast cakes

Table I—Dimensions and Weights of Vertically Cast Cakes and Wirebars Regularly Produced at the Carteret Refinery

Height, In.	Width, In.	Thickness, In.	Weight, Lb.
14	17	2½	185
14	17	2¾	200
13	13	4	200
14	17	3	220
20	11	3½	240
21	9	4¼	275
32	7	4	275
35	7	4	300
35	6	4½	300
25	10	4	300
18	13	4	287
26	13	4	400
31	12	5	575
30	16	4	600
27	18½	4	600
20	26	4	635
28	28	4	970
54(a)	7½	4½	565
32(a)	32	4	1,270
37(a)	37	5	2,120
66(a)	20	20	8,000
27½(ab)	4	4	140
54(ab)	3¾	3¾	225
54(ab)	4	4	250

(a) Not cast on No. 6 wheel. (b) Wirebars.

is insured. Rigid inspection of the final product also safeguards the quality. The fine appearance of the surface is brought out in Fig. 6, representing different views of a cake. Such cakes when rolled will give sheets with perfectly smooth finish on both sides. The parallel sides make them very well suited for edge rolling, and they may also be rolled to even width without the use of edge rolls.

An interesting view is given in Fig. 1, a polished cross-section of a 4-in. wirebar, showing distinctly the regular crystal arrangement resulting from the even cooling from all four sides toward the center. The diagonal arrangement of the crystals, a parallel of which is often found in steel ingots, where it is feared because it sometimes leads to cracking in the rolls, has been demonstrated to have no harmful effect in copper.

Production of vertical cakes at Carteret in 1933 totaled 42,000,000 lb. In addition to this about 5,000,000 lb. of vertically cast wirebars and about 6,000,000 lb. of billets were also produced. In 1934 the corresponding figures were: total production of vertical cast cake, 46,600,000 lb.; 8,700,000 lb. of vertical wirebars; and 9,700,000 lb. of billets.

Recently, Hirsch Kupfer und Messingwerke acquired the license for the process in Germany. Negotiations are also being carried out with interests in Belgium, England, France, and Italy. For Canada the license is being held by Ontario Refining Company, Copper Cliff.

I am indebted to Mr. Heath Steele, president of American Metal Company, for permission to publish the information contained in this article, and to D. L. Ogden and Erwin Wunnenberg, director of research and refinery superintendent, respectively, for assistance rendered me during my visit to the plant.

Emergency Repairs to Turnbuckles

TURNBUCKLES on our road machinery required frequent repairing recently, writes Chas. Labbe, Death Valley, Calif., who adds that the emergency character of the repairs makes them worth mentioning, especially as most difficulty was experienced with left-hand threads, for which no dies were available.

In the accompanying sketches, Fig. 1 shows the repair of a rod broken at the left-hand threads. As a couple of threads were left, the rod was heated in the forge to a fair redness and the threads were forced on hot by the turnbuckle, holding the rod in the vise. By repeating this procedure several times, sufficient thread length was provided in the turnbuckle.

Fig. 2 shows the repair of a fastening rod, in which the left-hand threaded part broke at the last thread. As the piece required a somewhat complicated forging at the other end, a plain round piece was threaded on a lathe in town. Both ends were bent square and the coupling was made with a short piece of flattened 2-in. pipe.

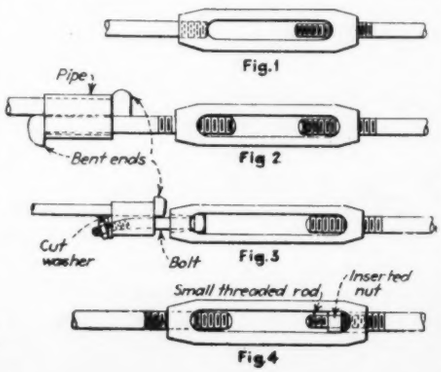


Fig. 3 shows a turnbuckle, the worn left-hand threads of which pulled out. The repair was made by inserting a plain machine bolt, the fastening being completed outside with a flattened piece of pipe of sufficient size to accommodate both pieces.

Another repair, shown in Fig. 4, was made on stripped right-hand threads, by threading the end of the rod to a rod of smaller size and then inserting in the turnbuckle a nut of smaller size tapped out to rod size. Turning the turnbuckle gave the same adjustment as that which had existed previously.

When possible, some turnbuckles were heated and hammered to permit retapping to original size. Although the site of operations was far from any repair shop, these makeshifts prevented any suspension in the work that was under way at the time.

Corduroy as a Gold Saver

An early method of recovery is revived and applied on a steadily increasing scale by important producing interests in South Africa, Canada, and the United States

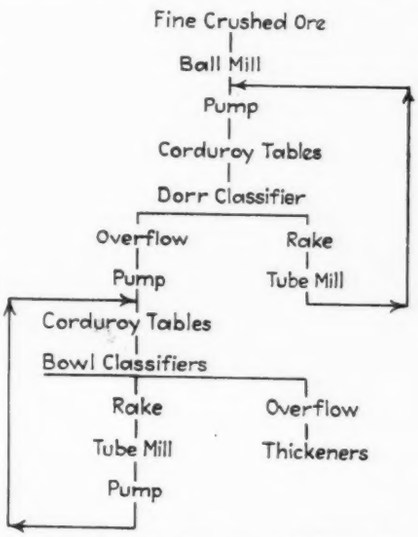
M. W. von Bernewitz
Metallurgist, Columbus, Ohio

A WESTERN SUBSCRIBER *of "Engineering and Mining Journal." after reading the author's article on Kalgoorlie, Western Australia, in the issue of March, 1934, wrote him regarding the use of corduroy in saving or catching gold, and suggested that an article thereon should be of practical value to millmen. The Editor agreed, and the information, covering world-wide methods, follows. Mr. von Bernewitz's observations were made in two plants treating respectively 50 and 250 tons per day, and in two other plants each handling 1,500 tons daily.*

KNOWN to all millmen as an early practice, one that dates back as far as Agricola's time in the sixteenth century, and one that has been employed to this day, is the use of blankets, coco matting, canvas, and corduroy—in fact, any material with nap—placed mainly after copper plates to catch any gold not held by them; also to catch some heavy minerals. From this practice has come the present use of corduroy alone to entrap the gold. It has largely replaced amalgamation on the Rand, is satisfactorily used in Australia, is being used in Canada, and is slowly being introduced into the United States. Doubtless its use will spread, and instead of the United States Bureau of Mines' statistics stating that amalgamation saves 35 per cent of our gold, they should also tabulate what corduroy does. Although corduroy concentrates are ground and amalgamated, corduroy is not amalgamation; yet it depends on mercury for the clean-up.

Of course, the use of corduroy is affecting and will further affect producers of mercury and makers of copper plate. Perhaps we should apologize for drawing attention to corduroy, but this change to an effective and cheaper method of gold recovery is one of those happenings. A parallel is the growing effect of flotation on the use of cyanide. The more gold ore that is floated the less need for cyanide, especially if only concentrates are cyanided. Even the cyanide used as a depressant in flotation of base-metal ores will not make good this loss. Yet, the more flotation is employed the more reagents are required. And so on.

What Is Corduroy?—Corduroy is a thick and durable cotton stuff or cloth, corded or ribbed—a pile or nap on a base. Most mining men and millmen have worn corduroy suits; women do also. But, as shown in the accompanying illustrations, corduroy for apparel differs from that used in gold recovery by reason of the narrower and closer cords or ribs of the former. Also, industrial corduroy has a nap that has been cut as is the pile on certain high-grade floor rugs, thereby offering innumerable spaces for entrapping gold.



Flowsheet of Lake View and Star mill

The material is known as a "pulp sifting corduroy cloth." It is woven from special material, and, after being put through a serrating machine, it has a deep pile or nap with strong backing. Then the cloth is shrunk. The manufacturer did much experimentation and spent considerable money in developing the cloth. It is made up into bales of about 80 yd. in two widths, 28 and 36 in.

Source and Price of Corduroy—All of the gold-saving corduroy used is made by James Johnson, 18 London Road, Manchester, 1, England. In the United States the agent is The American Cyanamid Company, Rockefeller Center, New York City. In Canada the agent is Peacock Brothers, 660 St. Catherine St., W., Montreal, Quebec. The price in New York is about $1.50 a yard; in Montreal $1 per running yard for 28-in. and $1.27 for 36-in. corduroy; in Australia 3½ shillings (about 84c.), and in Africa 4¾ shillings (about $1.19).

When to Use Corduroy—The question will be asked, "When should we use corduroy and if and when copper plates?" No decided answer can be given, because both give satisfaction on ores containing coarse gold and/or fine gold. On the other hand, when we consider the cost of copper plates, the more or less skill required to keep them in good order and in removing amalgam, mercurial poisoning, theft of amalgam, loss of time, effect of bad water and scouring by coarse pulp, and their general supervision, corduroy is preferable because it is not expensive, it does not require skilled labor, theft is not so simple, and a remarkably big flow of pulp can be passed over it, gold and minerals being caught meanwhile. Homestake experience favors amalgamation as being a cheap method of gold recovery and it leaves less gold in the pulp for the cyanide solutions to dissolve. Waihi does not amalgamate, although a streak of fine gold is visible on the Wilfley tables; this gold with the concentrate is ground and cyanided raw. Even if an ore is ground finely, use of corduroy in the flowsheet may be advisable to catch the larger particles of gold which might prolong cyanidation. Of course, the flotation men may say, "Install a single cell and a hydraulic cone in the tube-mill-classifier circuit and save the gold"; but its purpose is to catch coarse gold before flotation of the fine gold and minerals.

Corduroy is not always satisfactory. In the Kolar gold field, in India, where 646,000 tons of ore was treated during 1933, it was tried, but blanketing is understood to be preferred. We have heard of a similar finding in one or more mills of the Western United States.

What is known as "rusty" gold is amalgamable with difficulty, if at all. The metal may be coated with one of several elements, and sometimes with iron, and occasionally with manganese,

as in New Guinea. Copper plates will not catch this sort of gold but corduroy will.

In laying corduroy, the cords or ribs are, of course, placed across the table and flow of pulp, with the high side of the nap facing the stream. Each length overlaps the succeeding length a few inches. Some millmen turn up the edges so they may rest against the sides of the tables, whereas others hold it down by means of easily removable laths. But the arrangement is a matter of convenience or as found to be most practical.

In general, according to Peacock Brothers, the slope of the corduroy table must be determined by actual trial, the size and specific gravity of the solids and the liquid-solid ratio being the principal factors that influence the slope. An unclassified pulp with up to 20-mesh sand at 4 or 5 to 1 dilution will flow down a 1¾-in.-per-foot slope; dryer and finer pulps need less slope; dryer and coarser require more slope. Build the tables with a 1½-in. fall, with an inch or two to spare at the bottom of the table. Then saw off the bottom legs until the proper slope is found; or, make the legs telescopic for adjustment.

As the operation of flowing gold-bearing pulp over corduroy is one of concentration, and as the concentration ratio desired is a high one, no sifting should take place on the corduroy, or the small riffles will become inactive and not collect gold. Roughly, 3 tons of ore passing over the tables should have 1 square foot of corduroy. The cloths are rinsed every 24 hours or less, and this is continued until the pile or backing gives way.

The use of corduroy is growing in Australia, and New Zealanders are becoming interested in it. At present, Kalgoorlie has the greatest use of the material. I saw tables on the Boulder Perseverance, Hannan's North, and Lake View and Star plants. Probably it is in the flowsheet of the new 400-ton flotation plant at the Great Boulder. The corduroy tables are enclosed by stout wire netting, so that unauthorized persons can be seen if they break in, and so that the pulp flow may be watched.

At Golden Plateau—This mine is at Cracow, Queensland. The ball-mill discharge is screened and the fines pass over four primary corduroy tables, each 3 ft. wide and 8 ft. long. They are arranged so that two strakes receive the feed while the other two are being cleaned. Later, the tube-mill discharge flows over four secondary corduroys similar to those described, according to a description which appears in *Chemical Engineering and Mining Review* for July, 1933.

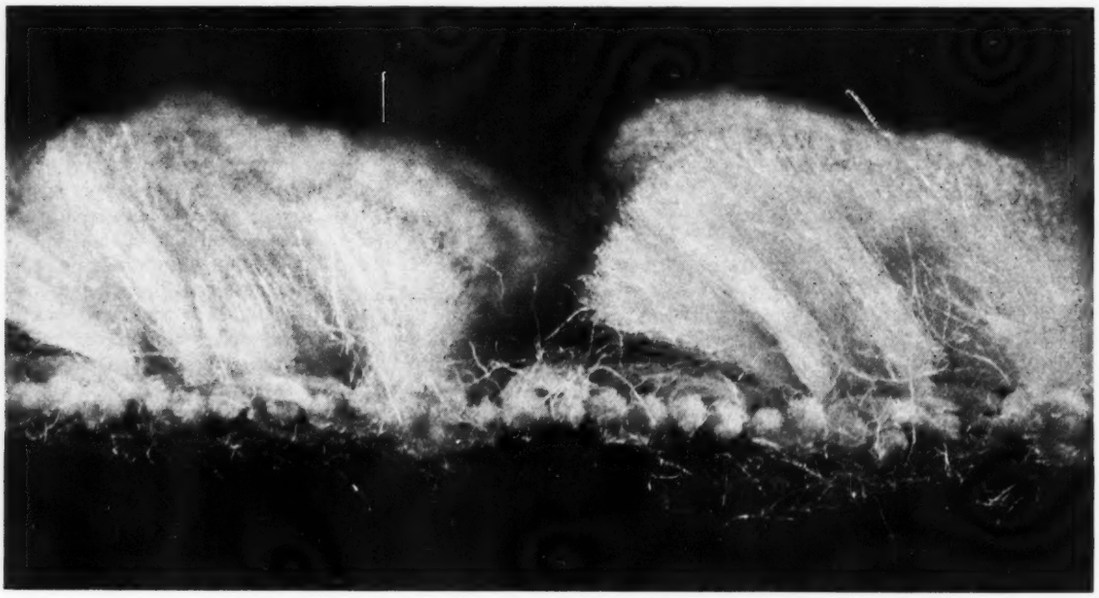
At Hannan's North—This mine, at the north end of the Kalgoorlie field, produces a sulphide ore and some free gold. Ten stamps, using cyanide solution, crush the ore through 10-mesh screens. The pulp flows over 40 sq.ft. of corduroy sloping at 1 in 8. This is washed at change of shift, and perhaps more often. The concentrate, which carries 30 per cent of the total gold, is ground and amalgamated.

Kalgurli Ore Treatment—At this joint Boulder Perseverance-North Kalgurli (1912) plant, treating 400 tons of sulpho-telluride ore, the pulp direct from the Hardinge ball mills and the rake product from the Dorr classifiers runs over sixteen 3x5-ft. corduroy tables set at 1 in 8. The flow is gentle and wavelike, similar to stamp-mill pulp on copper plates. These tables save 20 to 30 per cent of the gold, which is ground with mercury in a barrel in the usual manner.

At Lake View and Star—As shown in the accompanying flowsheet, corduroy is used in the ball-milling and fine-grinding sections of the plant. As practically no free gold can be observed in the flotation feed under the microscope, almost complete recovery on the tables is assumed. The objection to copper plates is loss, by theft or otherwise, of amalgam, as mercury finds its way into every nook in the pulp flow. Corduroy has been in use at this plant for three years.

A sieve test of the pulp flowing over the primary corduroy shows 5 per cent on ¼ mesh, 10 per cent on 10 mesh, 25 per cent on 20 mesh, 35 per cent on 60 mesh, 10 per cent on 100 mesh, 1 per cent on 150 mesh, and 14 per cent through 150 mesh. Of the pulp passing the secondary tables, 20 per cent is plus 200 mesh. The gold varies from microscopic grains to flat pieces up to $\frac{3}{16}$ in. in diameter. The grade of the primary tables is 1 in 8 and of the secondary tables 1 in 10. Both sets are 3 ft. wide and are 6 ft. and 10 ft. long, respectively. The pulp flow is 8 tons per square foot per day over the primary corduroy and 15 tons over the secondary corduroy.

The wide-ribbed corduroy costing 3½ shillings (about 84c.) per yard is favored. It is laid so that the deeper projecting part faces the stream of pulp. To have a series of extra deep ribs, cloths are cut and resewn with the overlap against the stream. All cloths are washed each morning, but the primary are changed every 12 hours and the secondary every 24 hours. The respective life is six months and nine months.



A vertical section of the gold-saving corduroy, enlarged about eight times

A charge or cost per ton should be placed against milling for corduroy.

The company discards everything except the concentrate, which is roasted and cyanided. Corduroy was used to catch the gold in the pulped calcine, but it has been replaced by cut onion sacks. This burlap costs 6 pence (about 12c.) each sack and is of about 6 mesh. The calcium sulphate formed in roasting clogged the corduroy and rendered it difficult to wash.

The 3x10-ft. calcine tables have a fall of 1 in 10, and the pulp flow is 1.3 tons per square foot per day of material, of which 100 per cent passes 200 mesh. The sacking is washed each morning and is changed every 12 hours. It has a life of four weeks. Corduroy saves 23 per cent of the total gold in the company's ore, which comes from a group of several mines.

At Dome—Corduroy has been in use in the Dome mill, Porcupine, Ontario, since the beginning of 1932, but prior to that and as early as 1920 ordinary wool blankets were used following amalgamating plates. This combination of amalgamation and blankets was used until 1929, when the mill was destroyed by fire. The new mill was started up as an all-cyaniding plant, no blankets or corduroy being used, but extraction was low and cyanide consumption high during the grinding, owing to the presence of pyrrhotite in the ore. Experience showed that if the grinding was conducted in water, the pulp could be cyanided with a small loss of the reagent and lower residues.

The ore, after passing through the ball mills in open circuit, goes to classifiers feeding tube mills, also in open circuit; the discharge of the tube mills and the classifier overflows then come together and pass over the corduroy tables. The pulp then passes to a set of gravity cones whose overflow constitutes the finished product as far as grinding is concerned. This material is thickened and then cyanided by agitation in Pachuca tanks. The cone underflow is sent to secondary tube mills, with classifiers; the rake product from the classifiers makes one pass through the tube mills and joins the classifier overflow, to pass with the pulp from the primary tube mills over the corduroy tables. The material is evenly spread over each table by means of a circular rubber mat having grooves radiating from the center.

From the foregoing one can see that the separation of the sufficiently ground pulp from the circuit is effected by the cones, the classifiers being used practically as tube-mill feeders.

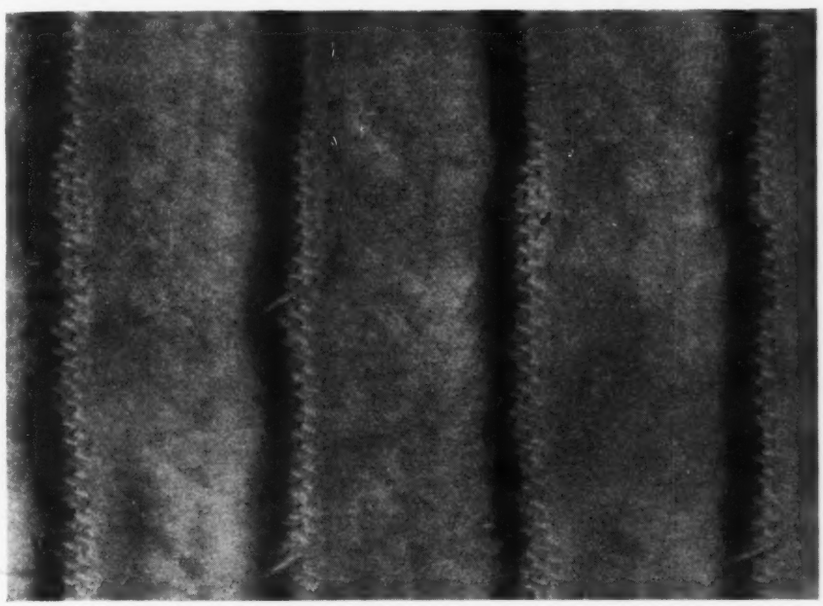
The combined flow passing the corduroy tables contains about 60 per cent minus 200-mesh material; the finished product has about 90 per cent. Inclination of the corduroy tables is about 1½ in. per foot, they being constructed so that a slope of 1⅜ to 1¾ in. can be obtained. The corduroy allowance is 756 sq.ft. for 1,500 tons crushed, the total tonnage including the circuit being about 3,500. Effective length of the 28 tables is 6 ft. and effective width 4½ ft., giving an area of 27 sq.ft. per table.

The corduroy comes in rolls of about 28 in. in width, with the cords running the length of the material. The cloth is cut off in 5-ft. lengths. Four lengths placed across the table fill the space. This means that the cords run across the table. The top strip of corduroy, which of course catches more gold than the ones following, is changed about five times in 8 hours; the lower strips are changed less frequently. Life of the corduroy is about 100 days.

The gold ranges greatly in size, some being very coarse; but, on the other hand, some is very fine, for the cyanide extraction is very susceptible to the fineness of grinding. Recovery by the corduroy is 77 per cent of the gold contained. This figure will vary with the increase or decrease of the amount of coarse gold, so that the extraction will range from 75 to 80 per cent.

In the instance of the Dome mine, recovery of the gold by using corduroy is better than when amalgamating plates were used in the position now occupied by the corduroys. The reason for this is that some of the gold particles were "filmed" and were not caught by the copper plate. Recovery by the plates was about 62 per cent. The weight of concentrates saved by the corduroys is about 3 tons per 1,500 tons crushed daily.

At Siscoe—Ore from the Siscoe mine, Quebec, is mostly quartz, with never more than 1 per cent of sulphides. The gold is coarse and mostly free. The plant treats 330 tons per day. Coarse ball-mill discharge is classified in hydraulic cones, the underflow being concentrate, whose gold content is caught on Gibson tray amalgamators and on a silver-coated copper plate. The cone overflows go to Dorr classifiers, which are in closed circuit with the mills, and their overflows pass to other cones, whose overflow (38 per cent solids) in turn passes over three sets of four parallel corduroy tables, each being 4x12 ft., with a slope of 1⅜ in. per foot. One set of cloths is washed every hour. The corduroy concentrates are also amalgamated and account for 10 per cent of the total of 92 per cent of the gold saved by amalgamation. In other words, the gold in cone concentrates and in corduroy concentrates is finally recovered by mercury. Cyanidation extracts about 5½ per cent of the gold, so total extraction amounts to 97½ per cent.



Surface of the gold-saving corduroy enlarged about four times

Consumption of corduroy at Siscoe is about 0.002 yd. per ton of ore. The 36-in. material costs $1.19 per yard at the mine. It has been found to be effective and satisfactory. Besides recovering this free gold, it saves the coarse sulphides, which are ground in cyanide after first being treated with mercury.

At the Raub Mine—Practice with corduroy at the Raub mine, Malaya, according to A. S. Lilburne, in *Chemical Engineering and Mining Review* for November, 1933, is as follows: The gold is associated with quartz and calcite and small quantities of other minerals. Stamps crush the ore through about 25-mesh screens and 90 per cent or more of the gold is caught on copper plates, traps, and launders. Then the pulp flows over shaking corduroy tables, 4½x10 ft. Two pieces of cloth are used on each table, being wedged in by laths. The tables are cleaned every hour, the pulp

stream being deflected meanwhile. The cloths are washed in a trough of water. When the ore is of high grade (the average is 12 dwt. per ton) or high in minerals, it is run over another corduroy table, non-shaking. To raise the grade of the corduroy concentrate to 1 oz. per ton, it is run over a Wilfley table. During 1932-33 the corduroy saved 1,141 tons, which assayed 21 dwt. gold per ton—rather low-grade material. However, these tables reduced the gold content of the mill tailings, which carry 1.4 dwt. per ton and are not treated—rather a high value these days.

The revival of corduroy originated on the Rand, where copper plates had saved many millions of ounces of gold, and then with or by canvas tables alone more gold was caught. But, according to T. K. Prentice in the *Journal of the Chemical, Metallurgical, and Mining Society of South Africa* for September, 1933, "not all metallurgists on the Rand favor corduroy."

Excepting the newer plants, as Daggafontein and East Geduld, which are all-sliming, the majority of the mills use corduroy or the Johnson concentrator. The total amount of ore involved with corduroy is 2½ million tons per month, and the gold caught ranges from 40 to 55 per cent of the total.

As to the Johnson concentrator, its action and place in a plant were described by E. H. Johnson in the *Journal* cited for April, 1927. Briefly, it is a rotating drum with a rubber lining in which riffles and grooves are arranged as in the rifling of a gun. The sulphides collect in the riffles and, as they are carried upward, are removed by sprays. This machine recovers 44 per cent of the pyrite and 55 per cent of the gold in a concentrate weighing 8 per cent of the total. Its free gold content is removed on blanketing, and the pyrite is ground and cyanided with the mill pulp. In an East Rand Proprietary plant, corduroy tables followed the Johnson machine.

In summarizing his paper, "The Work of the Metallurgist on the Witwatersrand," G. H. Stanley referred to corduroy as follows in the *Journal* cited for November, 1929:

> Another feature of the old practice, which, as the result of local experience, may now be considered obsolete, is the amalgamated plate for gold extraction. . . . But their use was not free from objection; particularly since cases of mercurial poisoning were not uncommon . . . A reversion to ancient practice was tried and found effective as a gold catcher—namely, flowing the pulp over corduroy surface on which the gold and other heavy minerals settled and from which it was recovered by rinsing in water and amalgamating the deposit by turning in a barrel with mercury. This is now the method generally employed and effects a marked economy. Incidentally, it [corduroy] enables the recovery of another valuable constituent of the banket ore—osmiridium.

In his review of progress in Rand metallurgy, given at the 40th anniversary of The Chemical, Metallurgical, and Mining Society of South Africa on March 24, 1934, published in its *Journal* for that month, H. A. White stated:

> A committee, appointed in 1919 by the Chamber of Mines, commented adversely on some of the dangers to health involved in the current practice of plate amalgamation with mercury. This led to the introduction and rapid spread of corduroy concentration as a substitute. At the Van Ryn Estates, in 1918, Maxwell was using corduroy at the stamps, but it was first employed for recovering all the free-milling gold by F. Wartenweiler at the Modder East plant at Benoni in 1923.

Although written twelve years ago, Wartenweiler's paper in the *Journal* mentioned, for February, 1923, is one of the few and most complete references on corduroy. It is replete with figures and a flowsheet. It is entitled, "Recovery of Gold by Blanket Concentration in Substitution of Plate Amalgamation." In a group of large gold producers, plates had been saving 47 to 73 per cent of the gold. "Plate amalgamation," to quote Wartenweiler, "has gradually become encumbered with a number of disabilities. . . . With the increasing practice of fine grinding, the perfection of cyanide extraction and of precipitation, the importance of high recovery by amalgamation has receded according to the degree of efficiency of the section of the reduction plant devoted to recovery of gold by cyaniding."

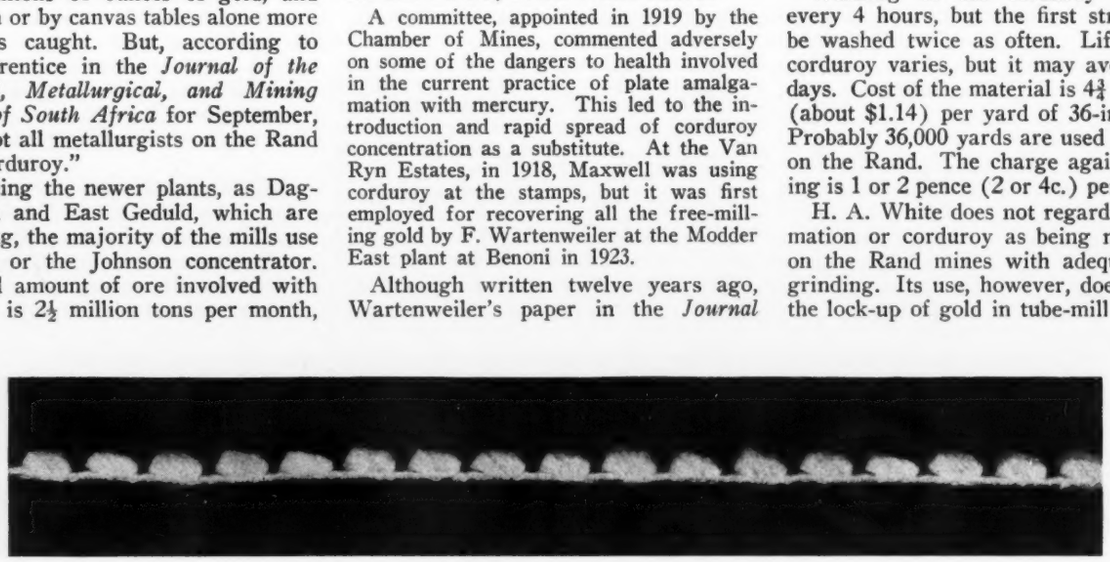
The Apex plant, treating ore from the Modder East, was among the first to discard plate amalgamation. The copper plates, from which accumulated amalgam had been removed, were converted to corduroy tables. No holding-down device is used, but air bubbles formed are "ironed out." Even distribution of the pulp for corduroy is as important as for plates. The cloth is washed every 4 hours.

Wartenweiler found, after a 4-hour run of pulp over a series of 5 corduroys, that the first table yielded 76 to 80 per cent of the gold recovered; the second, 11 to 18 per cent; the third, 3.1 to 4.2 per cent; the fourth, 2.3 to 3.7 per cent; and the fifth, 0.8 to 2.1 per cent.

Current Use of Corduroy—Corduroy tables are generally placed immediately after the tube-mill discharge. This pulp will carry 30 to 40 per cent of plus 90-mesh material. The average dimensions of a corduroy table are 5 ft. wide by 10 or 12 ft. long. The slope is 2 in. per foot. Each square foot of cloth may pass 1½ tons of solids diluted 3 or 4 to 1 with water.

Washing of the corduroy is done every 4 hours, but the first strips may be washed twice as often. Life of the corduroy varies, but it may average 35 days. Cost of the material is 4¾ shillings (about $1.14) per yard of 36-in. width. Probably 36,000 yards are used annually on the Rand. The charge against milling is 1 or 2 pence (2 or 4c.) per ton.

H. A. White does not regard amalgamation or corduroy as being necessary on the Rand mines with adequate fine grinding. Its use, however, does reduce the lock-up of gold in tube-mill circuits. At some plants, enough osmiridium is recovered as a byproduct to pay for the whole process of using corduroy.



Gold-saving corduroy, vertical section, actual size

Although we know that ordinary blanketing is used in some American mills, we feel sure that corduroy is also being used, but no information is available and discussion of practice will be welcomed by *Engineering and Mining Journal.*

Information Circular 6800 of the United States Bureau of Mines, 1934, "Mining and Milling Practice at Small Gold Mines," by E. D. Gardner and C. H. Johnson, presents many useful ideas, but excepting a flowsheet of the Porcupine United plant, in Ontario, that shows the use of blanketing, and a short paragraph on blankets, nothing is said regarding corduroy. In "Gold Mining and Milling in the United States and Canada," *Bulletin* 363 (1932) of the Bureau, C. F. Jackson and J. B. Knaebel have the following to say, in part:

> Blanket tables, consisting of flat, sloping surfaces covered with strips of corduroy, blanket cloth, coco matting, or coarse-woven canvas, are used in many plants. . . . The heavy minerals, including gold, sink to the bottom and are caught in the

riffles of the corduroy or between the fibers of the matting or other material that may be used. . . . Concentrates are washed from the blankets at short intervals.

Blankets, matting, and riffles have two rather distinct fields of use: In the earlier practice, blankets were chiefly employed as scavengers or guards to catch any gold not retained on the plates [copper] or saved on shaking tables, and they are still recognized as excellent devices for this purpose. Later, they became competitors of plate amalgamation and have directly replaced the plates in some mills, notably on the Rand. Although they [blankets] usually do not save as much free gold as plates, they cost considerably less to operate, and where the pulp is subjected to further treatment they frequently yield improved economic results.

Barrel amalgamation is the simplest and most common method of treating the rich concentrates caught by corduroy. A heavy, cast-iron barrel with manholes, revolving slowly, is used. In it are placed a charge of concentrates, steel balls or a rod or two, some water, lime and mercury. The whole may be run 2 to 12 hours. Then the pulp is taken out, the amalgam being caught in riffles and the fine pulp settling in boxes or tubs, from which it may be slowly fed into the mill circuit for cyaniding. The amalgam is retorted in the ordinary manner.

Any type of grinding and amalgamating pan will be suitable. In California an under-driven Berdan pan is reported to have been used for the clean-up of such concentrates. The Berdan is a simple machine and may be run in charges or with continuous overflow. It has been popular for many years in New Zealand and Australia for grinding small quantities of rich material and for cleaning amalgam.

At the Lake View and Star, the corduroy and burlap are washed in a hopper-bottom tank, and the settled concentrate is hosed into an amalgam barrel. This is run for 4 hours, and the pulp is hosed out over a sloping plate with a trap at the lower end. Only the amalgam, mercury, and coarse pyrite are withheld. These are panned by hand and the amalgam is treated in the usual manner. The remainder of the pyrite is pumped back to the flotation concentrate thickener.

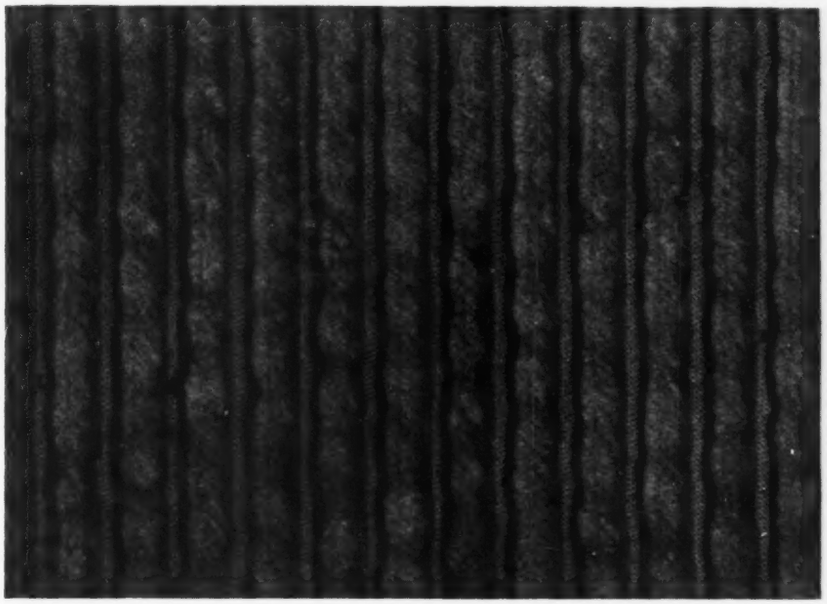
Treatment of the corduroy concentrate at the Dome mine is as follows: The material is ground in three steel barrels, charged with 1 ton each. Enough water and lime are added to maintain an alkaline condition. After grinding for about 19 hours, 1,000 oz. of mercury is added to each barrel and the grinding continued for 1½ hours. The purpose of the grinding is not so much to reduce the particles of pyrite as to brighten the surfaces of the gold particles so that, after the mercury has been added, rapid amalgamation will take place. If the mercury were added at the start of grinding, an appreciable loss of it would occur through flouring. After amalgamation has been completed, the barrels are discharged to a rotary apparatus, where the mercury and gold settle to the bottom and the sulphide and gangue overflow. The thin amalgam is cleaned by jetting water into it. Iron fragments are removed by a magnet. After the excess mercury has been squeezed out in a press, the amalgam is retorted. The value of the concentrate before treatment is $3,000 to $4,000 a ton, say 150 to 200 oz.; the tailings from the amalgamating barrels will contain 2 oz. per ton. These tailings are run into the mill circuit stream as it goes to the corduroy tables, so that any finely divided mercury in the tailings is immediately caught.

At the Raub mine, Malaya, the air-dried concentrate, which is refractory, is fed in 5-ton charges into a rotary, oil-fired furnace, roasted, ground in a tube mill, agitated with cyanide solution, and the gold precipitated on zinc shavings. Extraction is 94 per cent.

On the Rand, the concentrate is washed off the corduroy into collectors and settled in suitable locked containers. This is ground with steel balls in a cast-iron barrel for about 16 hours. Mercury is then added and 2 hours' more grinding is done. Then the barrel is discharged into a batea, in which the amalgam is retained, being subsequently cleaned, squeezed, retorted, and the gold melted. The overflow from the batea passes over concentrating tables of Wilfley or similar type. Osmiridium is here separated and the final residue is returned to the tube-mill circuit.

With regard to table treatment of corduroy concentrate, Wartenweiler, previously cited, tabulates his results from mill heads to cyanide residue. As an example: from crushing 27,000 tons of 10.86-dwt. ore, 4.02 dwt. were saved by concentration on corduroy. Its product assayed 138.3 oz. per ton, which was passed over a Wilfley table whose concentrate assayed 253.6 oz. (90 per cent finer than 260 mesh) and tailing 3.6 oz. This latter was returned to plant circuit. The amalgam yielded 32 per cent gold, which was equivalent to 34.6 per cent of the mill-head gold content. Plate amalgamation had averaged 41.8 per cent recovery, but mercury consumption was reduced 66 per cent. The clean-up barrel tailing assayed 16.3 oz. per ton and was cyanided with 97 per cent extraction of the gold content.

The concluding handling of worn-out corduroy is to burn it and treat the ash separately. Probably, it should not be fed to the mill circuit for fear that the carbon may precipitate the gold from cyanide solution. At the Dome Mines, Ontario, the old corduroy is thrown loosely into a tank, cyanide solution circulated through it for some days, after which the cloth is thrown away.



Surface of the gold-saving corduroy, actual size

I am much indebted to the following men for information on the use of corduray: B. Delany, sales engineer, American Cyanamid Company, New York City; C. W. Dowsett, metallurgist, Dome Mines, Timmins, Ontario, Canada; O. Matthews, mill superintendent, Siscoe Gold Mines, Siscoe, Quebec; M. J. Saunders, Peacock Brothers, Ltd., Montreal, Quebec; J. F. Thorn, general manager, Lake View and Star, Kalgoorlie, Western Australia; and H. A. White, metallurgical chemist, East Geduld Mines, Springs, Transvaal.

Simple Change in Flotation Cell Improves Both Concentrate And Tailing

Alfred B. Sabin

Mill Superintendent, Yellow Aster Mine, Randsburg, Calif.

● Froth allowed to overflow side of launder through weirs into adjacent parallel trough —gold recovery increased by 20 per cent

AN INTERESTING innovation has been worked out at the Yellow Aster mill, near Randsburg, Calif., in the course of treating the local gold ore by flotation. Treatment formerly consisted of amalgamation only. The tailings from these earlier operations amount to around 3,000,000 tons. The extraction obtained in working this tonnage of the original ore is estimated to have been about 80 per cent. In later years, however, the ores have not been so amenable to amalgamation. In fact, recovery by that method has dropped to about 60 per cent. In January, 1934, the Anglo-American Corporation, the present operator, installed two Kraut machines—one having six cells and the other five—following amalgamation, to increase the recovery. After much experimentation with the flowsheet, the following plan was adopted:

The first two cells of the six-cell rougher machine were used to pull a low-grade concentrate, and the next four to make a middling, which was returned to the feed. Tailings went to the pond. Concentrate from the rougher cells was sent to the five-cell cleaner machine, where the final concentrate was taken from the first cell. A middling from the next four cells was returned to the cleaner feed, and the cleaner tailings were pumped to join the rougher heads.

Results by this method showed a recovery of from 30 to 37 per cent of the flotation feed and a ratio of concentration of about 300 to 1. This was the situation when I took charge of operations at the plant.

Laboratory tests were then made, which proved it undesirable to let the grade of the mineral drop after having once been floated. In other words, a final concentrate should be made on the rougher machine, if possible, rather than to try to raise the grade of the rougher concentrate in the cleaner machine.

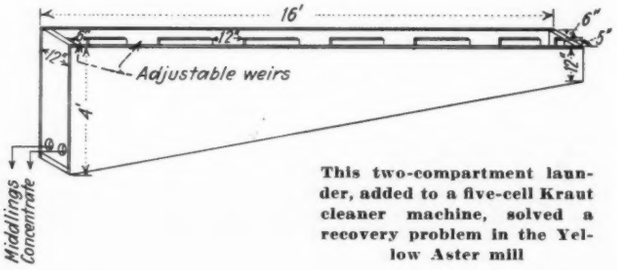
Before the correct solution to this problem was found, various expedients were tried. The difficulty in most cases was to get a high-grade concentrate. We observed, however, that the froth tended strongly to concentrate in the launder and that by pulling the machines hard enough we could make a froth which was high-grade in its upper layer and which could be made to overflow the side of the launder. Also, by this method we could get tailings lower than in any other way. A second launder was placed outside the first to catch the overflowing concentrate. The results were so encouraging that after watching its operation for a time, a new double-compartment launder was designed and built. As now installed, a final concentrate is made over the whole length of the six-cell machine, being drawn from the first launder compartment (or middlings compartment) to the second, over seven adjustable weirs placed opposite the cell divisions, each being 12 in. long except those at the ends, which are 6 in. in length. Addition of a set of paddles the full length might be an improvement.

From the middlings launder the middlings are drawn out at the bottom into a middlings sump. Tailings from the rougher go to the five-cell machine, which makes a second middling, and this in turn goes also to the middlings sump. All middlings join the flotation feed. Tailings from the five-cell machine go to waste.

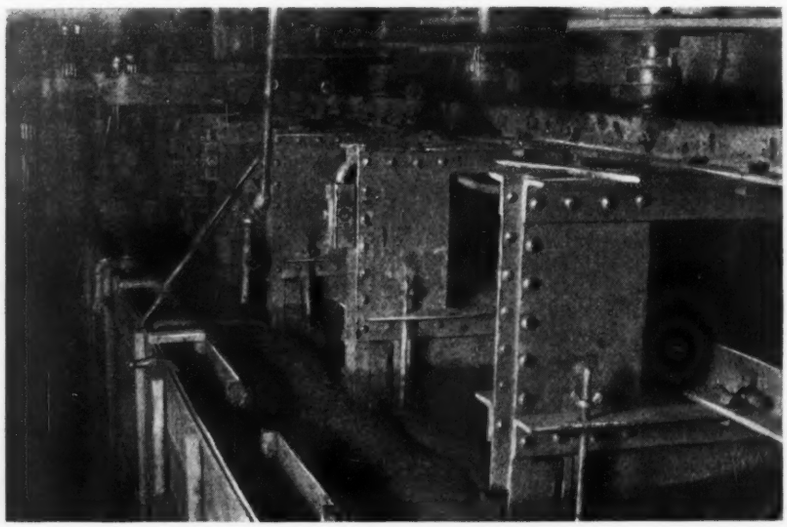
In the last analysis, one sees that what has been done is to use the middlings launder as a common spitzkasten for the six cells. The bulk of the concentrate is lifted only once. The result has been to raise recovery on flotation feed from between 30 and 37 per cent to between 50 and 57 per cent, with a present ratio of concentration of about 250 to 1.

Although the results at the Yellow Aster are not yet all that could be desired, it seems probable that further improvements will be made by cyanidation rather than by flotation. Nevertheless, the launder concentrate cleaner has more than justified itself in the mill, and the idea may prove valuable to others with a similar problem. Also, although here used with Kraut cells, the cleaning launder should give equally good results with other types.

I wish to acknowledge the help of the flotation operators who cooperated in the development of this idea.



This two-compartment launder, added to a five-cell Kraut cleaner machine, solved a recovery problem in the Yellow Aster mill



A view of the Kraut flotation machine with its modified concentrate launder working on Yellow Aster ore

Exploiting a Gold Ore Deposit In Honduras

S. E. Hollister

Metallurgical Engineer,
Southwestern Engineering Corporation
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•Air transport used for moving equipment and supplies to the Agua Fria mine—Flotation-cyanidation plant installed

WHEN the Agua Fria mine, near Danli, Honduras, was discovered, a quarter century ago, some surface exploration was done. Subsequently an arrastre was built near by, which has worked more or less continuously up to the present, treating one to two tons of ore per day by amalgamation, with a recovery of about half the gold. In 1918 the property was sold to Gamero Brothers, of Honduras, from whom it passed under option to T. C. Denton, of New York, in 1924. The latter built a camp, installed mining equipment, and opened the mine to about 300 ft. below the adit level, but allowed the option to lapse in 1930. Three years later, W. E. Winn took an option on the mine, later transferring it to the Cia, Minera Agua Fria, of which E. P. Halliburton, of California, is president; R. W. Prouty general manager, and Mr. Winn, mine manager.

The mine is isolated, being 8 miles from Danli and approximately 60 miles from Tegucigalpa. It is reached by pack trails from the highway connecting these two points. Situated on the Continental Divide, the camp is at 3,200-ft. elevation. Timber, principally pine and oak, and water are abundant. Temperature ranges between 60 and 80 deg. F. and the rainfall varies from 60 to 200 in. per annum, most of it falling in the winter season.

A strongly mineralized quartz vein, with quartzite walls, constitutes the ore deposit, the outcrop of which can be traced for more than 4 km. Present development includes a haulage tunnel, an inclined shaft, and three levels opened below the tunnel. On each of these the vein has been followed for about 1,000 ft. in either direction. With connecting raises this work has proved about 50,000 tons of 1.25-oz. gold ore. Above the tunnel level the ore is highly oxidized; below this point heavy sulphides appear. A partial analysis of a typical sulphide sample shows 1.20 oz. gold, 1.30 oz. silver, 0.60 per cent copper, 0.10 lead, 0.50 zinc, 2.48 arsenic, 0.10 antimony, 6.46 sulphur, 15.26 Fe_2O_3, and 64.15 insoluble.

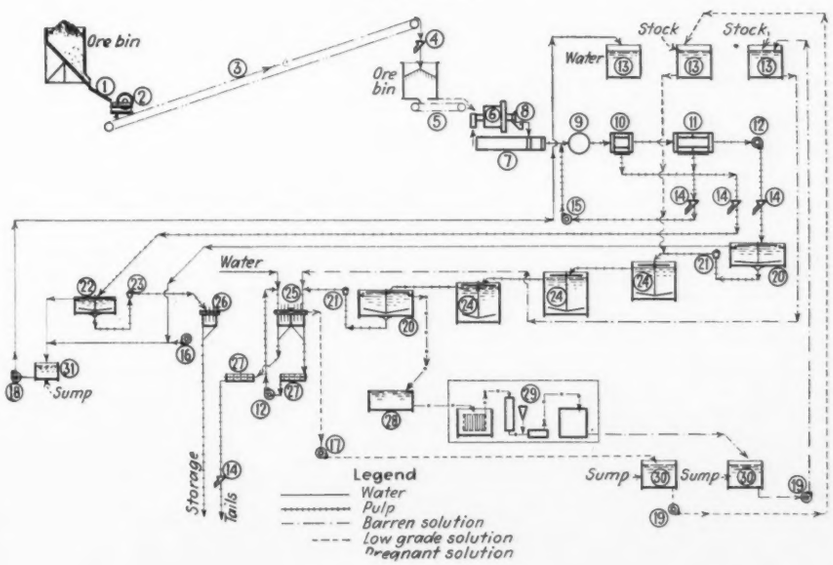
A program of modernization is now under way, including the installation of a hoist, compressors, and pumps, all electrically driven; also up-to-date drilling equipment, a blacksmith and sharpening shop, and a 200-hp. diesel engine, which will drive a 100-kva. generator for supplying power during the period of construction work and preparing the mine for production. Subsequently a 300-kva. hydro-electric plant is to be erected on the Agua Fria River, 3 miles from the mine. It will deliver current to the transmission line at 4,400 volts. Power circuits for mine and mill will be 440 volts. The lighting circuit will be 110 volts.

To treat the ore, a 50-ton flotation-cyanidation plant, designed and equipped by Southwestern Engineering Corporation, is being erected 1,500 ft. from the tunnel portal. In addition, the new plant includes a sawmill, a shop, an assay office, and a warehouse. Housing facilities are being provided for employees.

Because of the deficiency of ordinary means of transportation, airplanes are being used for taking in all equipment and supplies and for shipping everything sent out. A suitable landing field, 150x800 meters in dimensions, has been prepared about 3 miles from camp. Approaches are ¾ mile long. Grading was done with a tractor and road grader. At San Lorenzo, on the South Coast, an already established field was leased. Here the plane, a Ford Trimotor, is based. Incoming shipments are discharged at Amapala, transferred by barge to San Lorenzo, and thence trucked to the landing field.

The plane has a specially reinforced fuselage, equipped with a loading hatch, and makes two flights daily, weather permitting. The normal load is 2 tons of freight. Material 20 ft. long can be handled. When the mill is started, there will be an outload of 1½ tons of concentrate daily. Radio communication is maintained between the two fields.

Flow sheet of the Agua Fria mill, now being installed near Danli, Honduras. Flotation and cyanidation are to be used. Both oxidized and sulphide ores will be treated



EQUIPMENT LIST

Item	*Specification*
1.	Grizzly (Southwestern)
2.	Jaw Crusher (Telsmith)
3.	Belt Conveyor
4.	Head Sampler (Southwestern)
5.	Ore Feeder (Southwestern)
6.	Ball Mill (Marcy)
7.	Rake Classifier (Dorr)
8.	Gold Trap
9.	Conditioner (Southwestern)
10.	Flotation Cleaner (Southwestern)
11.	Flotation Rougher (Southwestern)
12.	Sand Pumps (Wilfley)
13.	Stock Tanks and Water
14.	Pulp Samplers (Southwestern)
15.	Sand Pump (Wilfley)
16.	Filtrate Pump (Worthington)
17.	Filtrate Pump (Worthington)
18.	Water Pump (Worthington)
19.	Solution Pumps (Worthington)
20.	Thickeners (Dorr)
21.	Diaphragm Pumps (Dorr)
22.	Thickener (Dorr)
23.	Diaphragm Pump (Dorr)
24.	Agitators (Dorr)
25.	Double-Wash Filter (American)
26.	Concentrates Filter (American)
27.	Repulpers (Oliver)
28.	Gold Tank
29.	Merrill-Crowe Precipitation Plant
30.	Sump Tanks
31.	Sump Tank

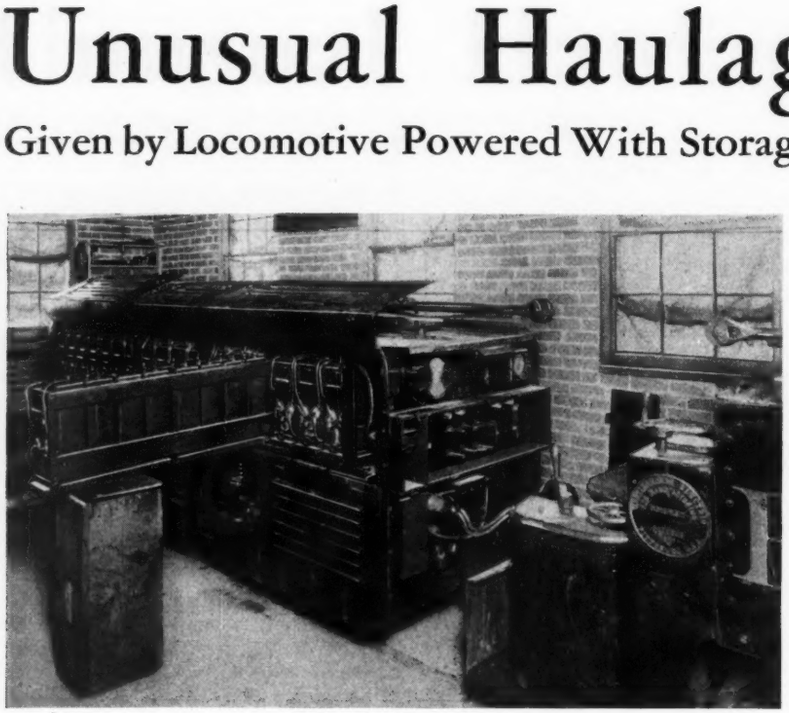
Unusual Haulage Service

Given by Locomotive Powered With Storage Battery Carried on Trailer

H. B. Barnes

Consulting Engineer
Denver, Colo.

Installation made 23 years ago at Idaho Springs property as best adapted to conditions has rendered efficient service with low maintenance costs and notable freedom from operating trouble and mechanical difficulties



Storage battery tender used with 4-ton Baldwin-Westinghouse locomotive at Idaho Springs, Colo. It is of 24-in. gage and weighs 8,200 lb. The battery consists of 208 A6 Edison cells assembled in 26 trays of eight cells each. This view shows one tray withdrawn for inspection. The locomotive is seen at the right

TWENTY-THREE YEARS is a long time when considered in connection with the operation of industrial equipment or machinery of any kind, and when installations gain this age they become of interest as evidencing a soundness of underlying theory which entitles them to real consideration. Such a case is that of the 4-ton Baldwin-Westinghouse locomotive which went into service at Idaho Springs, Colo., on Nov. 15, 1911, and, save for a period of comparative idleness during 1918 and 1919, has been in practically continuous service ever since. This locomotive is unique in that, instead of operating with the conventional type of trolley for which it was originally designed, its source of power has been a 250-volt storage battery carried on a tender, the battery being arranged and installed as shown in an accompanying cut.

The problem of finding a practical substitute for the horse haulage in use at this property prior to 1911 had been submitted for general consideration with a fairly definite set of conditions established. The property comprised over 2 miles of underground workings, many of them tortuous and constricted to a degree that made any type of overhead construction a serious problem, and with box-type ore chutes at loading points already in place, which offered further obstructions. The very narrow track gage of 24 in. and relatively light rail had also to be considered in working out any specification for locomotives for underground service, in addition to which there was an outside haul of half a mile to a metallurgical plant, and a comprehensive system of outside weighing and loading tracks around the tunnel mouth. Grades in the tunnel were designed for drainage purposes and averaged a quarter of 1 per cent in favor of the load, whereas the outside trackage was practically level, with but one fairly stiff short grade on the approach to a loading trestle. Available power supply was a 60-cycle three-phase public utility and the steam standby plant of the tunnel operating company.

Analysis of the problem was made from all angles. Overhead contact systems for both 250-volt and 500-volt direct current were laid out, also a complete plan for a 220-volt three-phase system with two overhead wires and rail return, but all of these involved objectionably high installation and maintenance costs. Stored-steam and compressed-air systems proved unattractive in the extremely limited underground clearances, and internal-combustion engine equipment involved ventilation problems. Several designs of self-contained battery locomotives were studied and discarded as the battery tender idea began to take form, eventually crystallizing into the equipment illustrated.

The locomotive is a standard 4-ton, 250-volt direct-current trolley type with the wiring modified for operation either on an ungrounded battery circuit or from the conventional overhead wire with which it was originally planned to equip the outside trackage. When operation commenced, however, we soon found that the battery capacity was entirely adequate for the whole job, and the outside overhead system was never installed; and the battery has continued as the sole source of power throughout the entire period of the operation.

Interest will of course center on the battery itself. It was a pioneer installation of its type, and roused some rather hostile criticism directed against the engineering "heresy" of carrying the battery as trailing load, rather than making its weight available for increasing traction in accordance with conventional practice. The battery selected consists of 208 "A6" Edison cells with a capacity at normal rating of 56.25 kw.-hr. The tender complete weighs 8,200 lb.—or practically the same as the locomotive. This battery, when partly charged only once a day, was found ample for the requirements of the property when operating one 8-hr. shift per day, the established practice being to operate it on the most efficient part of its capacity curve, and to avoid as much as possible complete charging or discharging. Two-shift, or 16-hr., operation was obtained by giving the battery short boosts at a high rate as needed, the ability of the Edison battery to utilize such charges efficiently being one of its attractions.

Charging equipment comprises a conventional motor-generator set which is connected directly to the battery without any series resistance, the charging rate being set by adjusting the generator voltage. Thus the battery is charged with a minimum of loss, and the motor-generator set is operated only a few hours per day, at full load and maximum efficiency, a condition much more favorable than is obtained with motor-generator sets operated on trolley systems where capacity for maximum

loads is kept in motion continuously to be available for peak loads of sometimes very infrequent occurrence. The all-day expense of operating such motor-generator sets in many cases will more than offset the electrical efficiency loss incident to storage-battery operation, and the ability of the battery tender to deliver full voltage to the locomotive motors, even in the most remote parts of the property, constitutes a further great advantage. On grades such as are encountered in this operation, and in most metal-mining operations, the loss in locomotive tractive effort incident to handling the battery as trailing load is on the order of 2 to 2.5 per cent, or practically negligible. It makes available, however, a capacity adequate to permit the locomotive to develop its maximum traction—that is, slip its drivers under all conditions of track and sand, without requiring a battery discharge rate in excess of about 150 per cent of normal, a rate which experience has proved cannot injure the battery, and it is this conservative operation which has contributed to the remarkably long life of the present installation.

With the removal of the stringent weight restrictions customary on self-contained battery locomotives, the designers were able to use much larger electrical equipment, in this case the motors being ample to slip the drivers without exceeding their safe commutating capacity. The two motors used are arranged for series-parallel control, and are also coupled mechanically through the side-rod drive, so that no wheels slip unless all slip. The ability of this locomotive to start heavy loads is one of its outstanding characteristics.

Thanks to conservative design throughout, this equipment has been remarkably free from operating grief. Total motor trouble consisted of several open circuits in one armature, due entirely to overheating of the commutator and throwing out of the solder on account of worn brushes failing to make proper contact. New brushes corrected this condition, which was not allowed to occur again. The usual minor adjustments and replacements of parts such as controller tips and fingers, brake shoes, pedestal guide shims and rod bushings have been required. Likewise, the wheel tires have required replacement and turning at intervals to compensate for tread and flange wear, which has been aggravated somewhat by the light rail section. Despite all this, the locomotive is as able as ever to deliver its rated service.

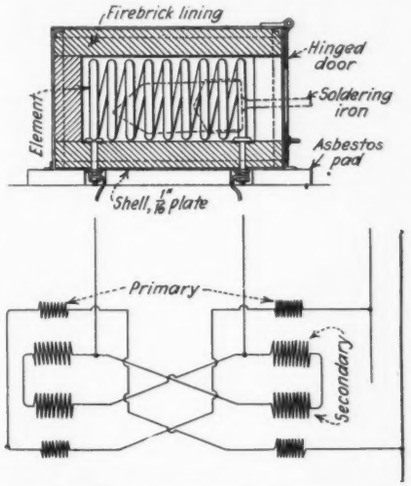
No mechanical difficulties whatever have been experienced with the battery tender, in spite of the low weight specified, which required the use of selected materials and very careful design. The cell arrangement gives a very low center of gravity and the type of bearings used holds the rolling friction to almost nothing. One set of wheels is worn out and a second set is well along.

Condensation of moisture around the battery incident to going from sub-zero outdoor temperatures into the warm, humid, underground atmosphere caused some insulation difficulties in the early months of operation, and most of the few cells which have been replaced were damaged in this way. Simple protective measures overcame this trouble as soon as the case was realized. The electrolyte has been completely replaced three or four times and the battery has of course been given regular and systematic inspection, filling, and cleaning, the tray units being arranged for quick and easy withdrawal from the tender as shown in the cut. The wooden trays and the impregnated wooden linings of the battery compartments have been replaced once. As a whole, however, the use of a 250-volt battery has proved entirely practical and eminently satisfactory, as shown by the maintenance costs, which were closely kept over a number of years. These averaged about 5 per cent on the first cost of the entire equipment, with about 2 per cent of this amount chargeable to the battery.

The engineers responsible for the original design of the Idaho Springs installation feel that a strong case has been made for the storage battery and that, instead of the compromise design of limited radius of action and capacity which the self-contained battery locomotive involves, the battery tender offers to properties having moderate grades a motive-power unit comparable in performance to the best of modern trolley practice and having the added advantage of concentrating the investment in a way which makes for remarkably low operating and maintenance costs.

Electric Muffle Useful in Soldering

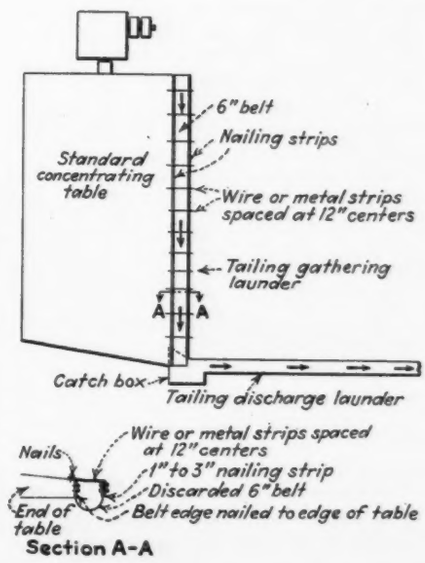
ABSENCE of a practical heating muffle often causes delay and extra expense at the electrical repair shop where a considerable amount of soldering work is done daily, writes L. E. Davis, chief electrician of the Santa Cruz Portland Cement Company, Davenport, Calif. Results obtained with the small electric furnace illustrated in the accompanying sketch in respect to performance, economy, and safety have been quite satisfactory. Both the furnace and the electrical auxiliaries were made from scrap material exclusively. The muffle proper consists of a shell made from ⅛-in. plate, reenforced with small angle irons and lined with firebrick, and a hinged door. A four-current transformer, connected as shown in the wiring diagram, and a coil-shaped heating element made from an old hairpin element from a muffle unit used at the laboratory, constitute the electrical equipment. Current is taken from a 110-volt line.



Special Launder for Table

A SPECIAL SETTING of a concentrating table, situated where sufficient fall for the tailing-gathering launder was not available, led to the development of the special launder shown in the accompanying sketch, writes Ray H. Poston, Flat River, Mo.

Inasmuch as ample fall was available for the discharge launder, only movement of the tailing to this launder was necessary. The special launder was fastened directly to the edge of the table, and the motion of the table while in operation effectively carried the tailing to the discharge launder, although it had no fall other than the natural table side.



Tellurides at Cornucopia

These gold minerals occur persistently in the quartz veins of this northeast Oregon district. In one mine they have been found over a vertical range of 2,000 feet

G. E. Goodspeed

Associate Professor of Geology, University of Washington Seattle, Wash.

WITHIN the past few years tellurides have been found in nearly all of the quartz veins of the Cornucopia district in northeastern Oregon. Lindgren, in his report on the Gold Belt of the Blue Mountains of Oregon, noted the presence of sylvanite in one of the minor veins of the district. He states: "The telluride is a silvery ductile sylvanite, covered by a film of dull-brownish gold and incased in normal vein quartz." A pocket containing $7,000 of this ore was found a short distance below the Robt. Emmet vein.[1]

In 1925 Shannon described petzite from the Last Chance vein as a massive mineral occurring with and intimately associated with calcite. He stated that it contained 1 per cent of chalcopyrite and gave the following chemical analysis[2]: Silica, 0.60 per cent; gold, 23.04; silver, 42.0; iron, 0.44; copper, 0.32; sulphur, 0.12; and tellurium, 33.44.

All the quartz veins at Cornucopia are presumably genetically related to a stock of granodiorite intrusive into folded Mesozoic sediments and volcanics which are now metamorphosed to schists, hornfelses, and greenstones. Some of the veins are wholly within the invaded metamorphic rocks, many of them angle across roof pendants, and a few are practically entirely in the granodiorite intrusive. The roof rocks are traversed by numerous dikes of porphyry, granophyre, and aplite, and are also invaded by irregular apophyses of granitic rocks which are usually more acidic than the main intrusive.

Many of these tongues of granitic rock give evidence of assimilation along their contacts and some contain small lenticular quartz veins rich in pyrite. This mineral is also disseminated in the adjacent schists. Local post-mineral faulting is negligible, although dike injections of Miocene basalt and diabase are common. An excellent discussion of the general geology of eastern Oregon is given by Gilluly in a recent publication of the United States Geological Survey.[3]

Petzite is by far the most abundant telluride, and its chief occurrences in the mines at Cornucopia have been in the upper workings of the old Red Jacket and some 2,000 ft. to the west and 500 ft. above this location in the upper levels of the Last Chance vein. Recently, however, tellurides have been found on the 1,600 level of the Last Chance vein approximately 2,200 ft. down on the vein, below the outcrop. They are always associated with the later metallization, commonly with the later clearer quartz, and appear to prefer veins not exceeding 2 ft. in width or irregular quartz lenses within or traversing the larger veins. This is the case of the so-called China Shoot lower workings of the Last Chance mine. The most common occurrences of petzite are in the form of irregular clusters of the steel-gray mineral a fraction of an inch to several inches in size (Fig. 1). In some of the larger clusters petzite bears an interstitial relationship to clear quartz crystals which have well-developed prism faces. Petzite also occurs in minute veinlets surrounding quartz grains and in minute transverse cracks. Calcite is commonly present, and small amounts of chloritic material are occasionally associated with the telluride.

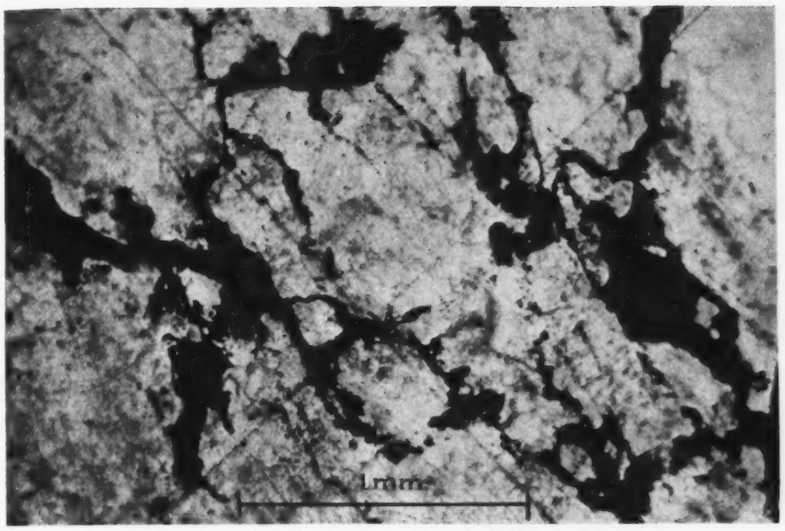
Fig. 1—Petzite occurring interstitially with clear quartz crystals. Natural size

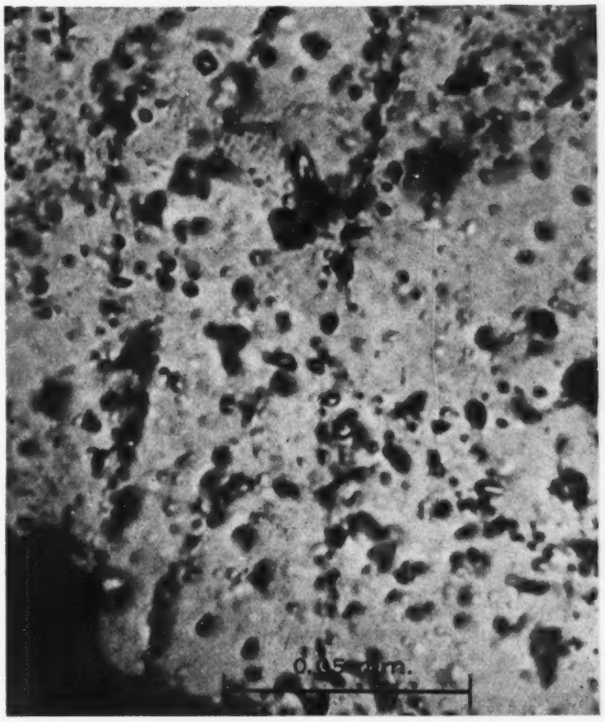
Previously formed ore minerals, in particular the earlier pyrite and the later chalcopyrite, are especially susceptible to replacement by petzite. Thin films of this mineral surrounding pyrite crystals are common, and many sections show minute fractures in pyrite filled with petzite and a partial to complete replacement by the telluride. In the case of sphalerite, the replacement seems to have taken place in small irregular blebs rather than along fractures, resulting in a dissemination of petzite in the sulphide.

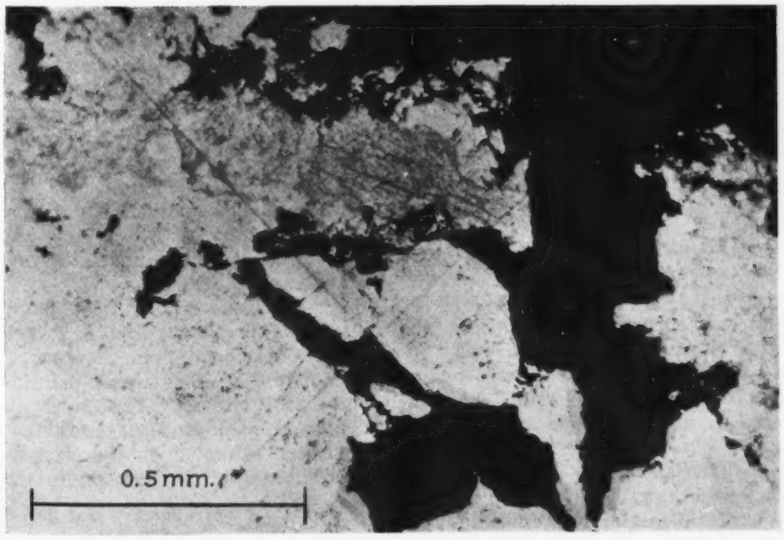
Microscopical studies of numerous sections of the Cornucopia quartz veins show that the tellurides have been formed during the latest epoch of hypogene metallization. They follow zones of microbrecciation (Fig. 2), replace earlier turbid quartz as well as the earlier ore minerals, bear an interstitial relation to the clear later quartz, and are also roughly contemporaneous with carbonate (calcite) chloritic material, and native gold. Photomicrographs of high magnification (600X) show that the turbidity of the earlier quartz is the result of innumerable vacuole inclusions, many of which are partially filled with liquid (Fig. 3). Similar features of quartz veins have been noted by Ferguson in his extensive studies of the gold-quartz veins of the Alleghany district of California.[4]

In one section from the Red Jacket mine there is an interesting development of crystalline carbonate surrounded by a fibrous-like intergrowth of carbonate, chloritic material, petzite, and native gold (Fig. 4). Immediately adjacent to this carbonate the petzite has partly replaced earlier quartz and pyrite, and native gold has been deposited upon the pyrite.

The gold-quartz veins of Cornucopia may be considered from a genetic standpoint as ranging from lower to upper mesothermal. In the lower levels of the







Union Companion vein, some 500 ft. vertically below the present workings, pyrite was the predominant sulphide and pyrrhotite was abundant. Above these lower levels pyrrhotite disappears, pyrite continues, and sphalerite, chalcopyrite, tetrahedrite, galena, and tellurides appear. In one of the veins, the Wallingford, to the west and above the Last Chance, gelena is very conspicuous.

As might be expected, the irregular distribution of the tellurides causes gold and silver values to be very erratic and makes accurate sampling a difficult matter. The recognition of tellurides is by no means simple, and, unless they occur in large clusters or their presence is indicated by that of native gold, microchemical methods are usually necessary to determine them. However, W. E. Johnston has recently given a simple qualitative method for the recognition of tellurides. "In short, it consisted in spreading, particle deep, a few particles of the concentrate on a pyrex glass slide and heating them in a bunsen flame. The telluride fused, leaving a characteristic island surrounded by a pool of tellurium oxide."[5] This recognition of tellurides is of considerable importance not only from the standpoint of mining geology but also with regard to methods of mining and treatment.

Fig. 2, Upper left—Photomicrograph of petzite replacing quartz in zone of microbrecciation

Fig. 3, Center—Petzite replacing earlier turbid quartz. The high magnification of this photomicrograph shows the vacuole inclusions which cause the turbidity

Fig. 4, Lower left—An intimate intergrowth of petzite and calcite is seen in the upper portion of this photomicrograph. The higher relief of the carbonate distinguishes it from the quartz.

Occurrence of tellurides at Cornucopia is of interest not only on account of distribution and persistance of these minerals in the various veins of the district, but perhaps more especially because of the range in depth of about 2,000 ft. in the Last Chance mine.

[1]Lindgren, Waldemar: "Gold Belt of the Blue Mountains of Oregon." Twenty-second Annual Report U. S. Geological Survey, Pt. II. 1900-1901. Pp. 561-776.

[2]Shannon, Earl Victor: "Petzite From the Last Chance Mine, Cornucopia District, Oregon." Wash. Acad. Sci. Journal, Vol. 15, No. 14. Pp. 342-44.

[3]Gilluly, James; Reed, J. C.; Park, C. F. Jr.: "Some Mining Districts of Eastern Oregon," U. S. Geological Survey, Bull. 846 A, 1933.

[4]Ferguson, H. G., and Gannett, R. W.: "Gold Quartz Veins of the Alleghany District of California." U. S. Geological Survey, Prof. Paper 172—1932.

[5]Johnston, W. E.: "Tellurides, Problem or Alibi." *E. & M. J.* Vol. 134, No. 8. August, 1933. Pp. 333-34.

Mechanics and Mining

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A. S. Toering
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THE factory system has low production costs because large groups of men operate modern equipment under efficient supervision. One acquainted with present underground mining knows that, as a rule, comparatively small groups of men are scattered over large areas. Efficient supervision under these conditions is difficult and expensive. New mining systems, making possible the use of large groups of men and modern equipment under efficient and inexpensive supervision, will depend to a large extent on the open spans that can be worked and the cost of supporting them. Therefore, the importance of an understanding of the laws that govern the behavior of mine roofs and supports cannot be overestimated. Efforts to determine these laws have been undertaken.[1] The resulting publications[2,3,4] and field observations point to the conclusion that underground mines are structures, from the point of view of mechanics, just as buildings or other surface forms of construction are.

In comparing a mine opening with a surface structure it is interesting to note that the engineer in constructing the surface structure starts with materials whose structural characteristics (tensile, compressive, and shear strengths, various moduli, and elastic limits) he knows, and encloses a given volume. His main purpose, aside from architectural effects, is to enclose this volume with the greatest safety to the worker and with as little material and expense as possible.

The mining engineer starts with a given mass (that is, an orebody and surrounding materials), and it is his function to extract as much as possible (create a volume) of this orebody with the greatest safety to the worker and at a minimum of cost. If the overlying material remains intact and undisturbed, then the general similarity of the structures that mining and structural engineers create is evident. Both structures enclose volumes, and the structural material is not stressed beyond the elastic limits. Certain underground mines may therefore be considered as structures made up of beams and columns—the mine roof and overlying material being beams and the pillars and props columns. If the unit stresses in the roof and supports of a mine are within the elastic limits of stress of their respective materials, the structure is one designed within the elastic limits and will stand indefinitely.

Knowledge of the behavior of mine roofs and supports is vital in underground operations. Upon the correctness of their design depend the safety of the worker and, to a large extent, also, the cost of production

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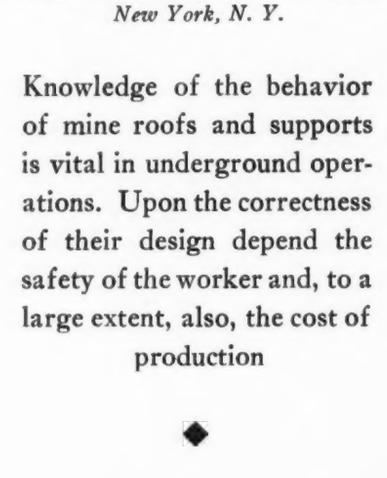


Fig. 1—Stress-deformation curve for steel (carbon = 0.71%)

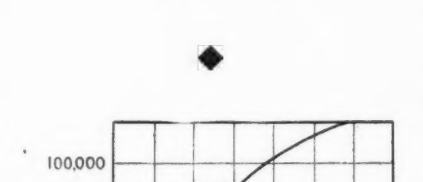


Fig. 2—Stress-deformation curve for sandstone (Kibbe, Mass.)

The laws governing the design of surface structures whose materials are stressed within the elastic limits are known to a large extent. Therefore, underground structures whose materials have the same general properties may have the same laws applied to them. It is evident also that the structural properties of the materials making up the geologic structure at a mine assume increased importance; the problem now becomes one of determining whether the rocks and ores making up the geologic structures have structural properties similar to those of surface structural materials, such as steel and wood.

To illustrate, compare steel[5] and stone.[5] Steel has an ultimate strength value in tension of 60,000 lb. per square inch, in compression of 40,000 lb. per square inch, and in shear of 48,000 lb. per square inch. The stone under consideration has an ultimate tensile strength of 200 lb. per square inch, a compressive strength of 6,000 lb. per square inch, and a shear strength of 1,500 lb. per square inch. It may therefore be said that as far as the ultimate strengths in shear, tension, and compression are concerned, the properties of stone and steel are comparable for design purposes.

Since the elastic properties of materials govern to a large extent their desirability for structural purposes, they must also be carefully considered. Figs. 1 and 2 show the stress-deformation curves for steel and stone. Here unit stress is plotted against unit deformation and certain items become of interest. On the steel curve one notices an elastic limit, the highest unit stress causing deformation in a body, so that, on the release of this stress, the body assumes its original shape and dimensions. This elastic limit is close to the yield point for steel and is fairly well defined. No such well-defined points appear to be available in the stress-deformation curve for stone. The steel stress-deformation curve also shows that for all stress values up to the elastic limit the deformation is proportional to the

[1] A research project of Engineering Foundation and Columbia University, sponsored by A.I.M.E.

[2] "The Use of Models for the Study of Mining Problems." A.I.M.E. T.P. 425.

[3] "Effect of Approximately Vertical Cracks on the Behavior of Overlying Roof Strata." A.I.M.E. Contrib. (4).

[4] "The Application of the Principles of Similitude to the Design of Mine Workings." A.I.M.E. T.P. 529.

[5] Data from Merriman's "Structural Engineers Handbook." P.550.

stress—that is, the material follows Hookes' law (the curve between these limits is a straight line) and the modulus of elasticity (unit stress divided by unit deformation) is a constant equal to 30,000,000. The stone stress-deformation curve does not follow Hookes' law—no part of it is a straight line.

The formulas for the solution of problems pertaining to beams assume that the material is not stressed beyond the elastic limits and that the material behaves according to Hookes' law. It follows that if the rock making up the mine structure has characteristics which meet within reasonable limits the requirements of Hookes' law, the known laws of mechanics may be applied to them and the structure be considered as designed within the elastic limits.

As the stone curve, Fig. 2, shows no elastic limit, the modulus of elasticity must be equal to the slope of the stress-deformation curve at 0 stress. In the design of structures with this material, if one uses a safety factor of 10 and the ultimate compressive strength of the rock is 5,000 lb. per square inch, then the design stress is 500 lb. per square inch. The design stresses in compression in the structure will therefore vary between 0 and 500 lb. per square inch. If a secant (O-B) now be drawn through the origin and the maximum working stress of 500 lb. per square inch, and it is found that this secant closely approximates the curve between these two points, then this secant may be assumed as the stress-deformation curve for stone. The assumption may then be made that the material behaves according to Hookes' law, and a structure of this material may be designed and assumed to be stressed within the elastic limits. That this can be done is evidenced by the numerous concrete structures, Old World stone structures, and mine openings which have supported themselves for long periods of time.

Experimental proof that sandstone has elastic properties is presented in Fig. 3. Fig. 3-*A* shows a sandstone model in a holder ½ in. high, with an open span of 5 in. and supported by three props. This model was placed in a centrifuge, and when still was photographed as shown in Fig. 3-*B*. It was then run at a speed equivalent to a model ratio[6] of 240, and, while running at this speed, was photographed as shown in Fig. 3-*C*. The pillar deformations signify roof deflection. The deflection at the center was then measured from the photographic plates and found equal to 0.013 in. This means that the surface sag in the field would be $\frac{240}{12} \times 0.013 = 0.26$ ft. The centrifuge was then stopped and photograph Fig. 3-*D* taken. The pillars are still bent but are actually free of the roof. Measurements from the photographic plate showed zero deflection. Therefore this stone was stressed within the elastic limits.

This experiment also suggests a means of determining the modulus of elasticity in flexure. If a fully restrained beam of material be subjected to a centrifugal loading and the deflection at the center determined, then the following formulas can be used:

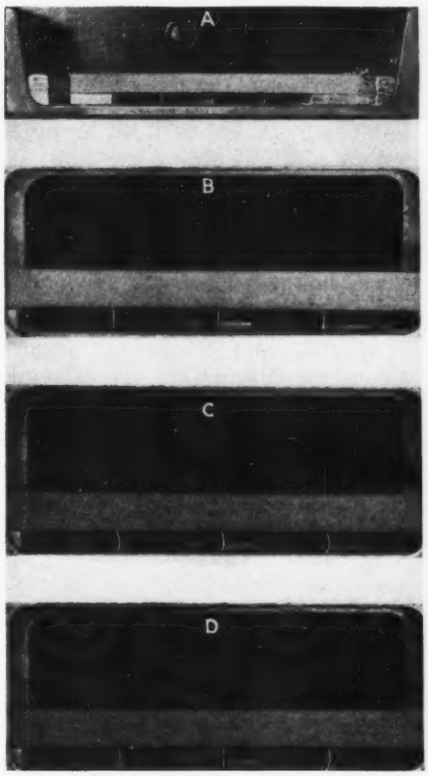


Fig. 3—Elastic Properties of Sandstone:
(A)—Before Placing in Centrifuge
(B)—In Centrifuge, R.P.M. = 0
(C)—In Centrifuge, R.P.M. = 1,000
(D)—In Centrifuge, R.P.M. = 0

$$E = \frac{wL^4}{384\,DI}$$

Where E = modulus of elasticity
w = load per unit length
L = span
D = deflection at center
I = moment of inertia of beam.

The modulus of elasticity for steel has been determined in this manner with an accuracy comparable to that obtained with standard testing apparatus.

Certain materials, such as clay, have stress-deformation curves of such a nature that they are not considered as elastic but as plastic. A small unit stress in clay causes a permanent deformation, and this material therefore has little value for structural purposes. The laws of plasticity are still imperfectly understood, and solutions pertaining to problems concerned with the behavior of materials of this type may be obtained by means of models.

A rock structure stressed within the elastic limits will assume a deflection and retain it until weathering or overloading causes it to be stressed beyond these limits, after which it will continue to deform until failure. Laboratory experiment has demonstrated that deformation beyond the elastic limit is a function of stress and time. It points to a possible means for determining the time element in mining operations, building settlement, and other fields of application.

Information concerning changes in the geologic structure and structural characteristics of its elements must be available. A liberal use of the diamond or short drill will furnish cores which will serve two purposes: (1) to give geologic information and (2) to furnish samples for structural tests. In some districts the dimensions and structural characteristics of a formation may vary considerably; in others they may be fairly uniform. Any local variation may be taken care of by means of a safety factor. The time is not far distant when it will be considered as unwise to furnish the same amount of support in different sections of a mine without knowing the geology and structural characteristics of the materials as it would be to keep on adding the same amount of coke or flux to a charge in a blast furnace without sampling and analyzing all three.

The general concepts of the effects of certain geologic features are also of interest. Certain of these have been accepted without definite proof. For example: it has been shown that the effects of vertical cracks in a mine roof may be negligible if the sides are in juxtaposition. A succeeding paper will show that important factors in mine roof behavior are: the relative thickness, structural characteristics, and position of the various strata that go to make up the geologic structure that includes an orebody. The bond strength of the layers will be shown to be of much importance. The stage is being approached where the effects of these elements should be determined, and much room for work of a fundamental character exists in this field.

A consideration of the facts presented leads to the conclusion that the known laws of mechanics may be applied in mining with due consideration of underground factors. Any mine structure stressed within the elastic limits is liable to solution. To solve mining problems by these methods it becomes important to know in much more detail the geologic and structural characteristics of the orebody and overlying material. This necessarily means a greater expenditure for geological and testing purposes. The

[6]Model ratio refers to the load on the model in multiples of its load in the gravitational field. See footnote references 2, 3, and 4.

desirability of this expenditure may be ascertained on the basis of an anticipated increased mine yield or lowered production costs.

Acceptance of the preceding provides a basis for the classification of underground mining systems based upon their structural characteristics rather than on their method of support or working. This classification may be stated as follows:

1. Mining systems whose structures are stressed within the elastic limits.

2. Mining systems whose structures are stressed beyond the elastic limits.

3. Mining systems whose structures are designed to be stressed within the elastic limits of stress for a certain portion of their life and beyond them for the remainder.

Under the first classification, mining systems whose structures are stressed within the elastic limits, would be listed all those systems of mining where enough of the orebody is left in pillar form, or additional support is provided, so that the mine roof and pillars experience only elastic deflections. This may be illustrated by room-and-pillar coal mining in Illinois, breast stoping in the zinc fields, and stoping methods in inclined seams or veins where sufficient pillar and/or artificial support is left to support the roof. Other underground openings coming under this classification would be tunnels, drifts, gangways, and inclines, so driven and supported as to stay open indefinitely.

Problems dealing with structures of the type mentioned in the foregoing may in general be solved by the application of known laws of mechanics or by means of models and the application of the principles of similitude.

Under the second classification, mining systems whose structures are so designed that the elastic limits of stress are exceeded, would be listed all those systems which at present are listed as caving methods. For the solution of problems dealing with these structures, recourse at present must be had to models and the application of the principles of similitude. Full-scale field tests can, of course, be used, if this be considered essential.

Under the third classification, mining systems whose structures are designed to be stressed within the elastic limits for a certain portion of their life and beyond them for the remainder, may be listed longwall retreating, the British bord-and-pillar system, or any system which first creates a series of pillars and chambers and then mines the pillars, allowing the overlying materials to be unsupported. Many of these systems in ore mining are listed under caving methods.[7]

The foregoing classifications and descriptions are presented merely to give a classification showing the systems to which certain types of structural solutions are possible. A later article will discuss the application of the known laws to specific cases.

Ore dressing and metallurgical discoveries have often resulted in the reworking of the ore and tailings dumps at old properties. The ore left to support old workings is still there, and it is evident that the pillars of old mines sometimes contain large tonnages of ore around which all or a great deal of the necessary development work has been done. Careful surveys and a solution of the structural problems involved at these properties may possibly reveal large tonnages that can be mined at a comparatively small cost.

[7]See Peele's Mining Engineer's Handbook. Section 10.

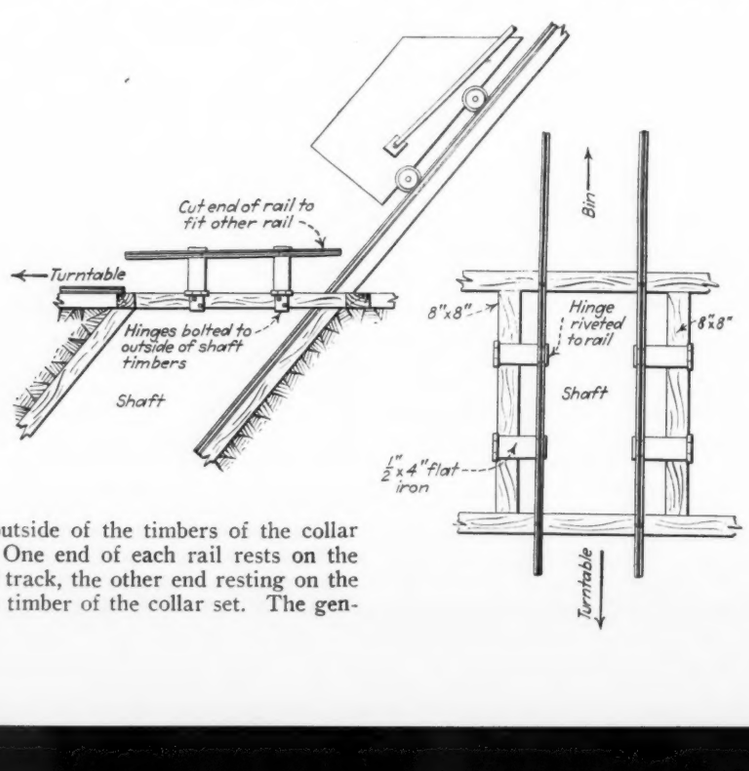
A Skip-Changing Device Of Light Weight

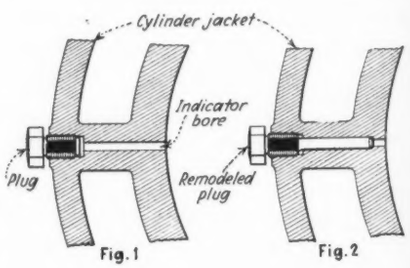
THE necessity of changing several times daily from ore skip to man-hoisting car led to the development at the Yellow Pine mine of a device notable for its lightness and simplicity writes Charles Labbe, from Death Valley, Calif.

At the inclined shaft, the movable track is made of two pieces of rail that move on hinges like a trapdoor. The two hinges of each side are bolted on to the outside of the timbers of the collar set. One end of each rail rests on the shaft track, the other end resting on the cross timber of the collar set. The general arrangement is shown in the accompanying sketch.

The outgoing skip is wheeled onto a light turntable and can be directed either to the blacksmith or carpenter shop or left on the track back of the turntable for the next change.

When the device is not in use, each hinged rail is raised and fastened to the shaft railing. The change is made by one man, usually the hoist engineer.





Gas-Engine Repair

UNSATISFACTORY performance of a 150-hp. gas engine, used at a mining property in Central Mexico to drive the crushing plant and mill, caused considerable annoyance, writes W. S. Morrit, master mechanic. To help solve the problem, several indicator diagrams were taken. These showed that the explosions responsible for the loss of power were caused by premature ignition during suction.

A careful examination was made of the engine valves and pipe lines, with negative results. Finally, a decision was made to remove the piston. Inspection of the cylinder bore disclosed that carbon particles and oil had accumulated in the indicator bore, shown in Fig. 1 of the accompanying sketch, which became red hot after the motor had been in operation for about one hour and caused the gas mixture sucked in by the piston to ignite prematurely. The trouble was overcome satisfactorily by enlarging the indicator bore and replacing the short plug with one having a cylindrical extension, as shown in Fig. 2.

Indifference to the Mine Shop Costs Money In Many Ways

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Mr. Gravlin speaks from experience gained in several positions in Latin-American countries. He has served as master mechanic and chief electrician with mining and oil companies in Ecuador, Venezuela and Costa Rica. He has also acted on frequent occasions as consultant on mechanical and electrical problems

- This is especially true of plants in Latin-American camps where conditions afford the mechanical department a greater opportunity to be useful

- Ignorance of Spanish is often responsible for a master mechanic's inability to develop the potential skill of native workmen

MUCH too frequently, in mines of small or modest production, the mechanical department seems to be looked upon by the management as a parasitical necessity. Official interest is often limited, apparently, to holding the payroll cost and the capital invested to a minimum. Because of this indifference, due to ignorance of the possibilities of decreasing costs when the mechanical department is operated efficiently, a valuable asset is frequently neglected.

An Opportunity for Saving

This is particularly true in Latin America. There, on account of the much lower wages paid native mechanics and the higher transportation costs, one will often find at a given property that many things that would be purchased from a manufacturer by a similar mine in the United States can be made at the mine much more cheaply. If care and experience be used in selecting the articles thus to be made, the savings effected will be real and will improve the balance sheet just as much as if they had been won by mining.

Perhaps it is because of the specialized training of a mining engineer that savings made on the surface are regarded as abstract rather than concrete. After a careful study, for example, it may be found that by burning lime at the mine a saving of several thousand dollars can be made yearly. At the end of the first month's operation the figures show that after making deductions for capital investment, for the lower grade of lime, and for additional labor, a monthly saving of $280 has been effected. In the monthly report is incorporated a statement, checked by the auditor, showing this saving, and the mine manager expresses his appreciation. The following month, however, he inquires of the master mechanic if it is really necessary to keep the extra men added last month. From then on, this regular monthly saving is regarded as something hidden in the mist of the dim past, and any talk by the master mechanic of the value of his department to the mine is seemingly looked upon as propaganda designed to secure an increase in pay for one of his men.

Unfortunately, a very sound reason exists for this skepticism on the part of the manager. Too many times he has known or heard of master mechanics, unable to converse in Spanish and afflicted with boredom, who have read an article detailing how a mine can be saved from the sheriff by making machine-drill parts. If the manager is unfamiliar with the symptoms, the disease follows a rapid course. A machinist is brought down from the United States, the necessary steel and tools are purchased, and the first act is over. A few months later, the manger finds that a ten-dollar drill part is being made for $4, according to the master mechanic's estimate, for $15, according to the auditor, and for $50, according to the mine foreman's estimate.

With a little patience all this difficulty can of course be overcome. If the mine be closed down and the spare capital invested in machine tools and heat-treating equipment, within a very few years a part almost as good and almost as cheap as the manufacturer's can perhaps be made. Most managers would not agree to this change, however, as they are more familiar with the management of a mine than with the efficient operation of a rock-drill factory.

Low mechanical maintenance costs are not to be expected at the mine at which the personnel of the mechanical department consists of a tropical tramp as master mechanic and a working force of peons who are unable, because of physical or mental defects, to obtain work underground, and where the equipment comprises a hand-driven drill press and a lathe with a bed that is reminiscent of the tune of "Sobre las Olas," all isolated in some dim corner of the mill or segregated in a tin-roofed shack. Such costs cannot be calculated from the payroll of the mechanical department. They properly should include the interest on warehouse stocks, the time lost in avoidable breakdowns, the compensation and hospitalization of employees injured by defective or worn-out equipment when working on it or near it, and such amounts as may be lost by not using the mechanical department to the best advantage.

Waste in the Warehouse

Interest on spare parts held in the warehouse alone amounts to a considerable sum yearly. Much of this expense is unavoidable. To attempt to make at the mine some types of machine parts is uneconomical or even dangerous. Anyone who is familiar with the warehouse of a mine which has been in operation for a number of years, however, is usually aware that hundreds and in some cases thousands of dollars' worth of parts are on hand, although the equipment for which they were intended has been discarded.

Some of this waste can be avoided

no doubt if a careful study is made of the parts list before the new equipment is bought. This should be made by a committee consisting of the manager, the master mechanic, and the head of the department in which the equipment is to be used. The master mechanic can advise as to cost, the time required, and whether or not the desired part can be made with the tools and material available. The department head can tell how long his equipment can remain out of operation without seriously interfering with the department's work. His advice should also be secured on the advisability of making any part at the mine from a standpoint of both safety and economy. Final decision as to whether the part under discussion should be purchased or made at the mine should rest with the manager.

Time lost in avoidable breakdowns is a more or less invisible waste, and because of this invisibility and the management's preoccupation with purely mining problems it is seldom investigated. Prevention is much easier than cure, nevertheless, and also much less expensive. It can be divided into two parts: inspection and maintenance. Unfortunately, the first of these too often consists of a weekly dash by the master mechanic through the mine, at which time he is primarily interested in keeping himself dry, and the maintenance in the application of large quantities of grease to the more prominent parts of the machinery.

Regular Inspections Vital

Daily inspection of all equipment should be made by a man, or men, designated for that purpose. At this time, all oil and grease receptacles should be filled and any excess wiped off. Dirty equipment tells its own story. When a man assigned to this work has completed his tour he should return to the office and make either a written or a verbal report. If verbal, a record should be made and filed. In this way minor troubles can be noted and remedied before they become serious, and major trouble will be known of far enough ahead to allow of its correction at some convenient time.

By checking up on these inspectors at irregular intervals, the master mechanic will not only keep them efficient but in this way will know accurately the condition of all his equipment every day. He should make the men understand that they are not being spied upon, but are being supervised.

Obviously, when using native labor, the only way to make these inspectors' reports useful is to convince the men of their value. This can be done if the master mechanic will personally investigate at once all reports showing any change in the operation of the equipment. This will impose extra work upon him at first, but within a short time the policy will bear fruit and most repair work will be reduced to minor replacements.

A quick way of determining the unavoidable breakdowns and those that are avoidable is to have a weekly sheet prepared by the master mechanic showing the reason, the labor cost, and the cost of materials for every job that interferes with production in mine or mill. Any job which consists only of the replacement of worn-out parts is avoidable.

The blacksmith standing at the anvil was later made foreman in charge of blacksmiths and steel sharpeners, a force of fourteen men. Trained at the mine he was entirely satisfactory in that position, and, in consequence, the master mechanic's supervision of that department was reduced to a minimum

In those cases where the equipment cannot be repaired without interference with production, the inspection will prove of value because it will enable management to provide, in advance of their actual need, the necessary parts and tools. The work can then be done at the best time without waiting for the breakdown to occur. When the work is handled thus, the equipment will be out of service only a quarter to a third of the usual time. Instead of wasting time getting materials and men together and hanging chain falls, this can all be done in orderly fashion. There is the further advantage that work so done is much safer, because the great need for speed does not exist as it does in the usual breakdown. Again, inasmuch as the work may be done in daylight it will progress more easily, safely, and efficiently than where artificial light is necessary. Finally, the master mechanic will find this procedure personally advantageous, as it will stop the annoyance of being called in the middle of the night. A master mechanic who complains constantly of regular interruption of his sleep is confessing his own inefficiency.

An Asset

A file of these inspectors' reports is perhaps one of the most valuable assets of the mechanical department. It will furnish a check not only on the material made at the mine but on that which is purchased as well. In this way one may find at times that, even though it will cost more, a certain part had better be made locally, as it will be better adapted to the particular conditions. Again, machine designers are human and make errors.

An instance from my experience will demonstrate this point. Two storage-battery locomotives were purchased from a company having years of experience in building such equipment. This particular model, however, was not past the experimental stage. Within a short time inspectors' reports showed that the driving axles were breaking at an alarming rate, in some cases in less than 24 hours. Upon investigation we found that, because of the short-radius curves and poorly leveled track in the mine, a single axle was subjected to a much greater strain than the designer had calculated. As the design of the axle housing prohibited the use of a larger axle, the problem had to be solved in another way.

The Solution

Examination of the broken axles disclosed that those purchased were too hard. It so happened that the mine cars used were made locally and that axle stock purchased for this purpose was therefore available. As an experiment an axle was made of this stock. It was not heat-treated and lasted about twice as long as the purchased axles. Its failure, finally, was caused by its being twisted apart rather than by crystallization. A second axle was promptly made, and this was heat-treated to give toughness rather than hardness to the steel. The trial was entirely successful, and, although this was some five years ago, such axles as are necessary for replacement are still made at the mine in preference to experimenting again with the manufacturer's product. This is unusual, as such a part is so vital that, ordinarily, it would not be manufactured locally, even though made more inexpensively. Again, the skill and the material necessary are not usually available.

That this particular job was done without tying up the mine haulage was primarily due to the system in use at the mine. While the locomotives were being assembled on the surface, the men inspecting the mine pumps and fans

were made familiar with the construction and relationship of their various parts. Anything obscure was carefully explained. The result was that upon the first breakage a report was turned in by the inspector that in his opinion the cause was due to the axles being too hard! As already shown, this was immediately acted upon.

Any extension of the mechanical department's functions obviously requires the cooperation of the management, the mine foreman, the mill superintendent, and the master mechanic. This cooperation should not be confined to throwing cold water on any and all suggestions made, but it should be a joint endeavor to lower mining and milling costs in any way possible. Mines are few at which costs are at rock bottom. It is much easier to say, however, that no improvement is possible than to make the effort to find the leaks and plug them.

Excellent groundwork for a start on the problem can be made by the manager. This may well take the form of a list of improvements that are possible in the mechanical department. Suggestions by mine and mill heads can be incorporated. If the master mechanic can be convinced that the intent is not to discredit or criticize the operation of his department, a big step has been taken.

A great many master mechanics on first being brought out into the sunlight in this fashion are likely to be somewhat embarrassed. Their embarrassment is increased when their opinion is asked upon questions pertaining to their department. Inasmuch as they have been given to understand for years that they should be seen and not heard, the sudden change is something of a shock. A little tact at this stage will prove helpful.

Although in some cases the purchase of additional machine tools will be warranted, these purchases should be carefully examined. In many cases the operation of such tools will require a high degree of mechanical training. Although this can be assimilated by native workmen, it takes an exceptional man to give it.

The work to be done at the mine will hardly call for other than the customary machine-shop equipment. Provision of this, together with a good master mechanic to direct its use, should be enough for a start and, usually, for future work.

Inasmuch as the master mechanic is the "mechanical department" to all intents and purposes, more care should be taken in selecting him. A man having nothing more than a mine training is incapable of handling such work efficiently at an isolated property. He may be entirely satisfactory in the United States, where service men from the various manufacturers are on call and warehouse stocks are within a few hours' distance. A different man is needed, however, when supplies take from a month to six months to arrive and, in an emergency, parts must be made from the materials on hand to avoid shutting down the mine.

Almost as necessary as mechanical training is the ability to speak Spanish fluently. To send a man to a foreign country and there put him in charge of men with whom he is unable to carry on the simplest conversation is ridiculous. This has been done in the past and will be done again. Today, however, the reason for it is less valid than ever before. Men with years of experience in Latin America are available.

This ignorance of the language accounts for the prevalent belief that Latin American natives cannot make good mechanics. Many "facts" are quoted to substantiate this. It is commonly said that the Latin American has no mechanical background, that he lacks the intelligence to understand mechanics, that he is not interested in doing good work, that he is not skilled in using his hands. And yet the same man who utters such a libel will purchase and bring back to his friends in the United States gold filigree work, beautiful iron work, fine Panama hats, spears, and blowguns, the latter with a bore made to micrometer accuracy with the aid of only a piece of cord and sand as tools. All this work is done by natives using poor tools and having no ability for mechanical work!

Where it exists, such lack of faith in the workmen is due primarily to the master mechanic's inability to direct and teach the natives, arising out of his ignorance of the tongue. Because of this deficiency he is reduced to gestures and cursing as means of communication. A better way of bringing any workman, native or American, to the point where he decides that the best policy is to know nothing has not as yet been found. Again, there is the old story of the man who asked the dog trainer for his method of training dogs. The answer was that first it was necessary to know more than the dog.

I do not seek to convey the idea that an Indian can be brought in from the

(Continued on next page)

Kirk Automatic Lead Trimmer

AN AUTOMATIC lead trimmer, invented at the Midvale (Utah) smelter of United States Smelting, Refining & Mining Company, is being used with complete success. Refined lead is cast in molds on a revolving table. Starting and stopping of the table splashes lead over the edges of the molds. Prior to the adoption of the automatic trimmer, two men were employed trimming the rough edges off the pigs with trimming bars before they were removed from the casting table.

The Kirk automatic trimmer consists of a horizontal cylinder mounted on two bearings that permit it to have a seesaw movement. The cylinder is equipped with a piston that works an extended rod on which has been mounted a broad chisel or knife much like that in a carpenter's plane. Compressed air supplies the motive power. The reciprocating movement of the main cylinder is produced by a small vertically mounted cylinder and piston placed on the outer end.

As the casting table moves, gears and levers actuate a set of four-way valves, thus synchronizing the operation of the knife with the movement of the table. The downward movement of the vertical piston causes an upward movement of the chisel and also of the horizontal piston. While in this position, compressed air is admitted to the other end of the horizontal cylinder, moving the chisel forward.

When the table stops, the chisel settles down on the inside end of the mold and, at the same instant, the piston of the horizontal cylinder starts moving outward. The chisel then moves into action, planing off the five pigs contained in the mold at one stroke. By the time it reaches the end of its stroke, the table starts again and the cycle is repeated.

The machine is mounted on the concrete floor opposite a point on the periphery of the table where the lead has solidified but is still comparatively soft. The success of the device depends on careful timing, sufficient power and weight, and proper setting of the chisel.

jungle and made into a toolmaker overnight. In one case with which I am familiar, a certain Quechua Indian had so little familiarity with mechanical objects that he had never even seen an automobile. After being employed for two years in the machine shop he asked one day if he might use the shop tools for some personal work. Upon inquiry as to the type of work he intended to do, I found that he and a friend in the carpenter shop had developed a desire for a phonograph. He was going to make the mechanism and his friend the case. A broken spring from the club Victrola was given him and he went to work. It took him about six weeks of his own time, as he had to make up hobs for the gears. At the end of that period the mechanism was assembled and placed in the case. It worked perfectly. A similar experiment is recommended to any master mechanic who is under the impression that natives cannot make good mechanics.

Unfortunately, this man, although an excellent machinist as far as practice went, had little theoretical knowledge. As I have already mentioned, we made our own mine cars at this mine. Wheels were cast in the foundry and the axles turned from rough stock. Inasmuch as Timken bearings were used, the machine work was rather close. To speed up production as well as to save wear and tear on the adjustable gages and micrometers, we decided to make up C and plug solid gages in go and no-go styles.

After these had been made and roughly ground, they were hardened and turned over to this native machinist to grind accurately to size. My custom in such a case is to have the first piece brought to me before work is started on the rest of the lot, even where this means some delay. Time is abundant but material has to be ordered from the United States. When the first C gage was checked, I found that both ends were the same, although accurate to 0.0005 of an inch. Upon being questioned, the man said he had decided that the men in the shop would not know how to use the gages anyhow, so he had made both ends the same.

Here was an excellent example of insubordination, impertinence, and general inability to become a good mechanic. Why? Because the master mechanic, in this case myself, had not explained to him the use of the gages. Half an hour was taken then and there to remedy this oversight, and the rest of the gages were satisfactorily completed. That afternoon, on returning from lunch, I observe this machinist giving a remarkably accurate lecture on production gaging to the other machinists, using for demonstration the gages he had ground that morning.

The concluding part of this article, to be published soon, will discuss the equipment of the mechanical department and the kind of work which can be handled satisfactorily and economically.

Industrial Pension

What Form Shall It Take?

How far shall the Government go? . . . Can Washington guarantee the cost? . . . Weakness of bureaucratic administration . . . A uniform plan unsuitable . . . Private management likely to be more efficient

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IN AN EARLIER ARTICLE (*E. & M. J.*, Sept., 1934, p. 413) I discussed the fundamental requirements of a sound plan for industrial pensions, sometimes referred to as retirement income, old-age insurance, or group annuity insurance. It was there made clear that a reliable plan must be: (a) funded—that is, purchased by monthly or annual premiums while the employee is an active producer; (b) contributory —that is, cost shared jointly by the employee and employer; (c) insured—that is, underwritten by a life-insurance company on a sound actuarial basis; and (d) adequate to provide the retired employee with at least the necessaries of life. The arguments on these points need not be repeated here.

More important at this particular time is further discussion of the form and administration of such industrial pension plans, especially in view of the active interest in the subject now being displayed by the federal Government. It is well known that social insurance is on the legislative program of the Administration, and that not only unemployment insurance but old-age pensions as well will receive attention at Washington. It is of the utmost importance that any federal action on old-age pension plans be well informed, lest unwise legislation result.

Before going further I want to express my belief that thoughtful and progressive leaders in American business and industry look with favor on the principle of industrial pensions for retired employees. Many sound plans are in effect, some large, some small. And where they have been adopted they would not be abandoned by either employer or employee. They exert a stabilizing influence throughout the organization because they definitely answer many otherwise bothersome questions regarding older employees of long service who ought to be retired. There is nothing visionary about these plans. They become a part of business routine and a source of satisfaction to all concerned. From a wide familiarity and experience with the subject I assume there is neither valid objection to the idea nor a desire on the part of American society to thwart general acceptance and adoption of sound industrial pension plans. In fact, the Administration's interest in the matter may be taken as an expression of popular desire.

Government's Rôle in Pensions

It is a question, however, how far the Government ought to go in legislating on the subject. Shall Congress pass a law making old-age pensions mandatory? If so, what plan shall be adopted? Shall we have a blanket law imposed on industry nationally, operated by a governmental bureau with all the funds in one pool? Or shall we have 48 varieties of pension plans operated by the states? Or shall we have a blanket plan for each industry throughout the country? In short, shall a legislative plan be imposed on industry?

In my judgment it would be extremely unfortunate if any such dictatorial policies should prevail. Whatever encouragement state or federal government may lend to the idea, each employer should be allowed to adopt a sound plan that will best suit the needs of his business. During the past two years we have had many revealing examples of the complex character of American business, and of the consequent difficulty of regimentation to conform to a single standard. This fact will be forced home most unpleasantly if any attempt is made to impose a uniform pension plan on the industries of the country. Each has many peculiar characteristics that call for special treatment. Geographical location, character of employees, sex, wage and salary rates, seasonal characteristics, labor conditions—all these affect a pension plan and must be taken into consideration if the plan is to endure and be satisfactory.

Legislation Looms

Let us look into a few of the factors of industrial pension plans as affected by governmental control through a bureau or private control through insurance companies.

Cost is an important item, both to employer and employee. Under private control through an insurance company it can be ascertained exactly for a stipulated number of years. Interest also is guaranteed. Thus industry can know in advance the cost of pensions just as in the case of other insurable risks, and can estimate it as a percentage of payroll. Can the government guarantee what the cost will be? Funds for pensions under public control would undoubtedly be invested in government securities on which a fixed rate of interest cannot be guaranteed, thus affecting the item of cost. And in the event of a deficit it would be necessary to resort to taxation.

In the matter of management it seems obvious that greater efficiency will result under competitive private control than can possibly obtain in bureaucratic administration. Insurance companies have not only demonstrated the managerial ability of their own personnel, but they are under rigid state supervision wherever they do business. The non-competitive aspect of bureaucratic control, on the other hand, would not make for the same degree of efficiency, to which would have to be added the ever-present threat of political interference by the party in power.

Earlier reference has been made to the necessity for sound financing of pension plans. Under the privately insured funded plan the pension is purchased while the worker is an active producer. Each contribution buys a definite amount of pension which in itself is a complete transaction, unaffected in any way by merger or bankruptcy. It is true that we have many state and municipal pension plans, but for the most part they are unfunded, and to that extent unsound. No reserve fund is set up, and pensions are paid out of current funds. Such methods would be disastrous for industry.

If we consider the diversity of industry in this country it will be evident that greater flexibility in pension plans is desirable than could be had under a blanket plan imposed by governmental authority. Each company ought to have its individual contract to fit the peculiar characteristics of the business and the needs of its personnel. Allowance can easily be made for alterations in the private contract with little effort or loss of time, thus insuring flexibility without prejudice to the interests of employer or employee. It is doubtful if this flexibility can be obtained under public control, as it would mean cutting a great deal of the inevitable red tape of bureaucratic administration. The seasonal industry offers a good example of special pension problems that are best met under private operation.

Retirement Conditions

At what age should employees be retired on pensions? When one attempts to answer this question one will again be impressed with the futility of a general pension plan. Conditions vary from industry to industry and from one occupation to another, so that a special plan for each organization is imperative if it is to be fair and satisfactory. Only under individual plans is it possible to adjust both age and pension to the varying conditions existing throughout the country. Our only precedent for a government plan is that embodied in the Railroad Pension Act, which has been declared unconstitutional in a lower court. It has been regarded as unsound, arbitrary, and unsatisfactory. The retiring age was set at 65, the maximum pension at $120 per month, and the maximum salary eligible for pension at $300 per month. Would industrial companies want to place a top limit of $300 per month on salaries eligible for pension? Under some insured plans now in force no limit is placed on salary, even of highly paid executives. In other cases limits have been placed at from $6,000 to $15,000, depending on conditions in the company.

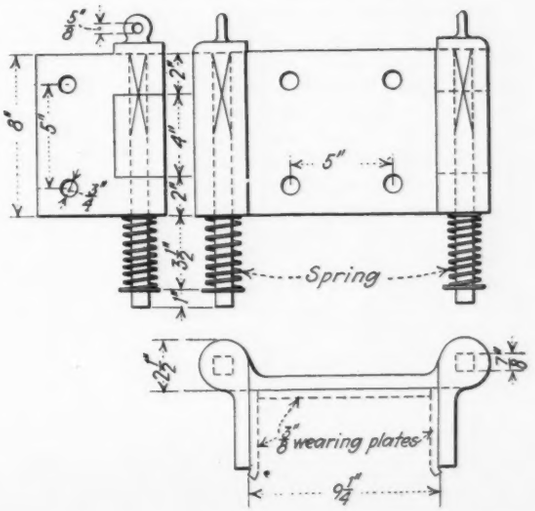
Enough has been said, I believe, to show that if the problem of taking care of old employees in industry is to be solved satisfactorily, it must be done by individual plans for each company and not by a general plan administered by a governmental bureau. Government may feel impelled at this time to vote public funds for the unemployed and dependent aged, but that will not solve the continuing problem of industry.

There has never been a time when the subject of insecurity of old age has been as prominent as today. Never before have there been such tremendous demands for public funds for the aged. Few can completely escape this worry over insecurity and none has escaped paying part of the bill for others. We can go far toward a solution of the problem by the united efforts of industry and its employees in sharing the cost of a well-defined, flexible pension plan.

Guides for Cages or Skips

IN OPERATING cages or skips in deep level mines, where thousands of underground workers are employed and many thousands of tons of ore hoisted per month, the length of time consumed in changing over from cages to skips and vice versa is important. A device in use on the Witwatersrand to shorten changing-over time is shown in the accompanying illustration. Its application obviates removal of the center runner generally used in the collar of the shaft.

Construction of the device consists primarily of forged-steel plates, reinforced on the inside with wearing plates of the same material. The outside plates are hinged to the guide, and may be locked in either the open or closed position. They are readily fitted to cage or skip, and reduce the total weight of either, four sets of the plates replacing on a side one full-length guide.



By means of this device the time required for changing from skip to cage can be materially shortened

II. Russian Copper

RESERVES of Kazakstan, Siberia, Transcaucasus and the Kola Peninsula, added to those of the Ural region, bring the Soviet Union's total to 16,220,000 metric tons of the metal. Despite these large resources, Russia, in the opinion of the authors, will have to import it in large quantities in the present decade if the country is to meet its ambitious industrialization program's demands.

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THOUGH the central Asia region contains the bulk of the Russian copper reserves—two-thirds of the listed resources to date, or over ten million tons of metal—its development has been delayed until the Second and Third Five-Year Plans, during which the Djezkazgan, Balkash (Kounrad), and Almalyk smelters will be constructed. This region, under the direction of "Yuzhtsvetmet" (Southern Non-Ferrous Metal Trust), embraces an area of 1,500,000 sq.km. of desert and steppe, east and southeast of the Caspian and Aral seas, which lies between 40 and 53 degrees of latitude and the 66th and 84th meridians. The following are brief descriptions of the copper districts.

Kazakstan and Central Asia

Much publicity has been given to the Balkash district (Kounrad) during recent years, on account of the elaborate plans made to mine the great low-grade copper deposits near Lake Balkash, which is at the eastern end of Kazakstan. The prevailing type of deposit in this district is porphyry copper, although bodies of copper magnetite have been found in the northeastern part, the latter being of secondary importance. Since 1928 more than 100 drill holes (totaling upwards of 14,000 meters) have been sunk in the Kounrad (locally "Konurat") deposit. Plans for Kounrad call for erection of a 42,000-ton flotation mill and provide that the district will ultimately produce 175,000 tons of copper yearly. Eighty-five million roubles have already been spent, but relatively little has been accomplished, and some time will elapse before the region will be in exploitation, inasmuch as several hundred miles of railroad must be built from Uspenski to Lake Balkash.

In 1930 the best technical talent in the Soviet Union—native and foreign—began an aggressive field development of the Kounrad project. The huge effort made in 1931-32, however, did little more than bring into Soviet consciousness the tremendous obstacles inherent in the creation of cities and the provision of transportation, supplies, and plant in this remote and desolate region. The project has by no means been abandoned, but a big change has been made in the schedule. Preliminaries of organization are reported to be progressing, but in more orderly fashion. In 1932, 24,000,000 roubles were spent in municipal construction at an entirely new townsite, on accommodations for 50,000 people.

This much-discussed Kounrad orebody—peculiarly similar in size and shape of deposit and in grade and kind of ore to the Ajo occurrence, in Arizona—is described as a low-grade secondary enrichment, enclosed in an annular dike of quartz porphyries which is an intrusion in monzonite, the latter being an intrusion among granites. The primary sulphide disseminations have a copper content of 0.6 per cent and less. The zone of oxidation (20 to 22 meters) carries 1.3 per cent; the zone of leaching (20 to 25 meters) 0.25 per cent. Average thickness of "commercial" ore is 110 meters, the average copper content being regarded as 1.1 per cent. Drilled resources (Category B) are now regarded by the Soviet as 2,136,000 tons of metal, with 350,000 tons in Categories C-1 and C-2. Chalcocite, chalcopyrite, and pyrite constitute the ore.

Balkash deposits of secondary importance are the polymetallic lodes at Kok-zobai, Gulshad, Kyzyl-espai, and Akchagyl. In the northeast Balkash region are contact deposits of cupreous magnetites (Saiak) in connection with the intrusion of granodiorites and porphyry-diorites into Devonian and Carboniferous sediments, carrying 1.5 to 2.0 per cent copper (40,000 to 50,000 tons, C-1 and C-2).

In the Kounrad district proper are several other lesser porphyry deposits—Karabash, Sokurkoi, and Borly. Throughout the district secondary quartzites are found extensively, with copper, molybdenite, gold, and corundum contained in small amount.

Although the orginal Kounrad mill was to treat 42,000 tons per day, a recheck of the sampling and further drilling indicated a lower copper content than had previously been estimated, so the capacity was raised to 54,000 tons in order to maintain the output of 175,000 metric tons called for. Two plans were considered: one, erection of a 10,000-ton leaching plant, modeled after the Inspiration installation, for treating the 13,000,000 tons of oxidized ore, and a 42,000-ton flotation plant for treatment of the underlying sulphides; and the second, a 54,000-ton flotation plant, having eighteen sections, three of which would be used to treat the oxidized ore and subsequently be remodeled to correspond with those treating sulphides. The second plan was recommended by the American consultants. Owing to the size and shape of the orebody, however, the latter were not in agreement as to the proposed capacity and reported that the economical limit for efficient operation would not exceed 20,000 tons per day.

The Tonnage at Kounrad

Estimates as to tonnage at Kounrad were indefinite while the plant was being planned, but were taken at about 180,000,000, which included the 13,000,000 tons of oxidized ore. Drilling had outlined the outer limits of the orebody in August, 1931, and the tonnage cited was supposed to be total. However, reports of other properties in the vicinity continued to come in, and possibly these would account for the difference between the figure given and that of 288,450,000 shown in Table IV. In the case of Djezkazgan and Kounrad, the Teksoviet went on record as favoring the inclusion of all ore which would run 0.5 per cent copper in tonnage estimates.

Part I of this article was published in the December issue. In it the authors discussed the copper industry in general in Soviet Russia and described in detail the Ural copper region. Part II concludes the article.

Whether this was done or not is not a matter of general knowledge.

One will note further that the figures of Table IV for the Balkash "A-B" category are lower than the 2,136,000 tons mentioned in the text as a recently estimated reserve of metal for Kounrad alone, and that C-1 and C-2 of Table IV are higher than the 350,000 tons of the recent estimate of the Soviet geological department. A transfer of categories is here apparent, some of the probable and possible reserves having been advanced to the drilled, or B, position. The best one can say for Soviet reserve figures is that they are of indicative nature only—usually on the upper side. They show broadly the relative order of the deposit under discussion rather than the exact dimensions that will be determined only upon fuller testing and development. Looking at it another way, the element of time is continually making good the total Soviet copper appraisals. New deposits steadily appear.

About 85 km. west of Ekibastuz and far to the north of Kounrad is the Boshtchekul district. The principal copper deposits are found at the contact of the sandstone and a granite dike 6 km. long, which is also mineralized. From 1930 to 1932, 68 holes, of which 40 have been in ore, were drilled in this area. The average copper content of the ore is low, however (0.46 to 0.93 per cent). In addition to this, copper is found in small pyrite lenses and quartz lenses (1.3 to 4 per cent copper) at

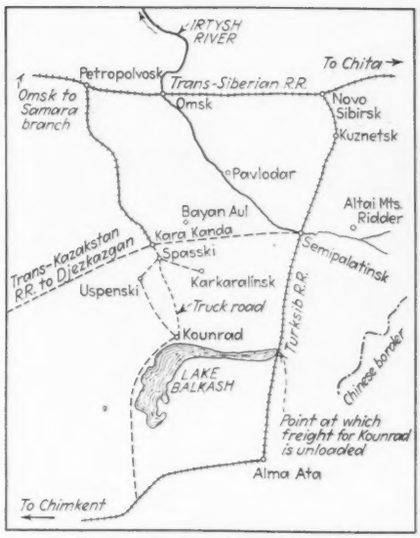


Fig. 1—The region adjacent to Lake Balkash

Maikain and in polymetallic orebodies at Bayan Aul. At the latter point several score of deposits occur, but all are so small that the locality is not yet of industrial importance.

Comparatively well known, the Spasski-Uspenski district is situated in the Kirghiz steppes, in southwest Siberia about 200 miles south of Akmolinsk and approximately halfway between the latter and Kounrad (Lake Balkash).

Fig. 2—The copper-bearing areas of the Soviet Union are scattered over a vast territory, as is shown by this sketch prepared from a map in the Soviet Union Year Book

Although more than 50 deposits are known, the Uspenski mine and the Spasski mines, which were formerly owned by the Spasski Copper Company, Ltd. (English), are the most important. The company located its smelter at Spasski and treated the Uspenski and Spasski ores there. The Uspenski mill was located on the Sara Su River, 6 miles from the mine. Plans for a new mill were completed in 1932 for erection at the mine. The Uspenski deposit, lying between a shale hanging wall and a graywacke footwall, contains 25,000 tons of metallic copper of 5.9 per cent average grade. Other important deposits are the Koktas-Djartas porphyry orebody and the Deghlen. Coal is available at Karakanda, and with the construction of the Trans-Kazakstan railroad it is expected that other low-grade deposits can be exploited.

In the western part of the Altai Mountains (near the southern boundary of Siberia and just west of the northern tip of Mongolia), in an area of approximately 40,000 sq. km., are polymetallic deposits of lead, zinc, copper, gold, and silver. Here in the Altai district the country rock inclosing the mineral deposits is composed of sediments (slates and tuffs are predominant) and igneous rocks (effusives and sills), which have been tilted and metamorphosed. The deposits, worked since the early eighteenth century, are located along two shear zones which have a northwest strike. Along the southwest shear zone the Irtysh group of mines is lo-

Kazak workers at home at Kounrad. A typical nomad family that has now settled down for work

cated and along the northeast shear zone are found the Ridder, Zmeinogoroskoye, and Zyrainovskoye groups. In some groups lead and zinc predominate, whereas in others copper and zinc are the principal minerals. The highest copper content is found in the Irtysh group, it averaging 2.85 per cent, accompanied by 6.8 per cent zinc and small amounts of gold, silver, and lead.

A zinc smelter is found at Belovsk (500 miles north of Ridder) and flotation mills have been established at Ridder. The copper from the polymetallic ores of the district is finally reduced to metal in metallurgical plants in the Urals.

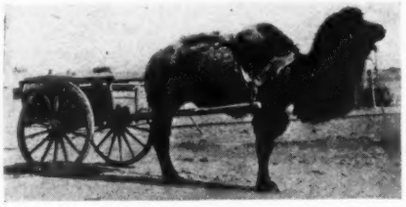
The Almalyk district is about 90 km. southwest of Tashkent, in Uzbekistan, the republic at the southern extremity of the Soviet Union, bordering Afghanistan. In this district ten copper porphyry deposits have been found, but drilling has been concentrated on only one, somewhat similar in geologic structure to Kounrad. This deposit has a thickness of over 200 meters and a horizontal area of approximately 0.87 sq.km. The grade is low—oxidized ores, 1.1 per cent; leached zone, 0.25; secondary enrichment zone, 1.0; and primary sulphides, 0.7.

The Djezkazgan district, although discovered by Rockov in 1771, was not claimed until 1847—by one Ushakov. In 1906 it was given to an English concession called "Atabasarski Copper Company." From 1918 to 1925 the district was idle, but in 1926 it was reopened and has been a producer of copper since 1929.

Djezkazgan covers an area of 1,000 sq.km. and is located 440 km. from Station Djusaly, on the Tashkent-Orenburg railroad in the semi-desert country of the Kirghiz steppes to the northwest of Lake Aral, reached only by horse and camel. The district is about 60 km. northeast of Karsakpai and roughly 700 km. west of Spasski and a little south. As to transportation, the road to Djusaly is passable for trucks during spring and summer, but, like all the steppe country, snows and high winds make travel and transport difficult in the fall and winter, and much material is scattered along this road where trucks have broken down or been unable to get through because of weather conditions. The Trans-Kazakstan railroad is now under construction to Djusaly.

The occurrences are in Devonian and Carboniferous sediments—no igneous rock in proximity—and consist of flat-dipping deposits which are found in seven separate ore-bearing horizons which are called the "Djezkazgan Productive Series."

To date an area of 100 sq.km. has been explored, of which 1.5 sq.km. have been drilled by over 460 holes. The result of this drilling has proven 37 orebodies, of which 15 have been explored. Extensive concentrating facilities have been designed for the Djezkazgan region. The Southwestern Engineering Company, of Los Angeles, during its two years of consultation to Tzvetmetzoloto, prepared complete plans for a 6,000-ton-per-day preliminary project in 1931, this flotation mill to be located near one of the larger orebodies. The projected capacity of this mill—500 tons per day in 1930, then 1,000, then 6,000, and by September, 1931, 12,000—made rapid jumps as successive orebodies were spotted, the Southwestern company engineers retaining the opinion that the proper figure should be 3,000 to 4,000 tons per day.



No iron horse, but always on time. This mode of conveyance is the typical way of handling light freight and supplies in Kazakstan

Table III gives the number of orebodies found in each area and the percentage of ore reserves.[1]

Southeast of Djezkazgan is the Golodnoya (Hunger) steppe, where the TasKura deposit, also embedded in Carboniferous marls and sandstones, is rated at 1.0 to 2.5 per cent copper, with a 50,000-ton reserve of metal.

A small flotation mill and smelter now serves this Djezkazgan district, at Karsakpai, some 60 km. to the northeast, and construction is under way for a smelter of 150,000 tons' yearly capacity. Although this district holds second place in "Yuzhtsvetmet," as far as its copper reserve is concerned, it may well be that within a few years it will occupy first place.

Table IV shows the copper reserves of the Kazakstan and Central Asia region.

Recent Discoveries

New copper discoveries during 1934 have been reported in the Chagot Mountains and near Kugitan village, in the Karlukski district, in Turkmenia, the latter being reported as large. One may reasonably expect that additional copper deposits will be found within this vast region and the copper reserves increased considerably, for many deposits are already known. Inasmuch as they have not been sufficiently explored, no consideration was given them in Table IV.

Fig. 1 shows the transportation routes into the Kara Kanda, Spasski, Uspenski, and Kounrad districts. Petropolvosk is the main-line junction from which daily trains run to Akmolinsk and Kara Kanda. Spasski is the central station for the distribution of supplies to Uspenski, Karkaralinsk, and Kounrad, fair truck roads running to these points. The railroad was supposed to reach Kounrad by the summer of 1932. Some freight was shipped via Novo Sibirsk and the Turksib railroad in that year and unloaded 6 km. from the east end of Lake Balkash, hauled to the lake, and transported on scows to Balkash. Due to shallow water and sand bars in the eastern half of the lake, which caused considerable trouble, this route was not used extensively. Lack of adequate transportation was the main reason for placing Kounrad on the reserve list, coupled with the fact that the equipment desired could be obtained only in the United States and conditions did not then permit purchase.

At present the plan is to construct a Trans-Kazakstan railroad from Semipalatinsk to Kara Kanda (the source of coal supply), thence through Djezkazgan to station Djusaly, on the Tashkent-Orenburg railroad. A branch to

[1]Tables I and II are to be found in Part I, published in the December issue.

the south, from Kara Kanda, is being built through Spasski and Uspenski to Kounrad and on to the Turksib railroad, which runs south of Lake Balkash to Chimkent. When completed, the Trans-Kazakstan railroad will serve all districts with the exception of Almalyk, but at the present rate of progress some years will elapse before this is accomplished.

Water is scarce in most of this semi-desert or desert country, and the long winters are extremely cold and windy. It will always be difficult to maintain an adequate labor supply, inasmuch as the average Russian (white) worker is averse to working in these out-of-the-way places. At the present rate of development (mills and smelters under construction in advance of railroads), it will take several years, despite its larger copper reserves, for Kazakstan to supplant the Ural region as the principal copper-producing section of the U.S.S.R.

Siberian Region

With the exception of the Minussinsk district, in Western Siberia, and the Verkhoyansk province, in Eastern Siberia, not a great deal is known of the copper deposits in the great Siberian domain. In general the known deposits to date are of minor economic importance.

In Western Siberia, the copper deposits are found in the Minussinsk district, about 300 miles south of Krasnoyarsk, on the Trans-Siberian railroad. Relatively little prospecting has been done, but, of the orebodies explored to any extent, the Ulen, Temir, Kayalykh-Usen, Julia, Dinmatika, and Karysh represent contact types. The Maïn deposit is a copper pyrite lens and the Bazyr deposit consists of irregular quartz veins with sulphides.

In the Trans-Baikal district, copper deposits and copper indications have been found in a large number of places, some of which are along the rivers Budiumkansky, Shergun, Ildikan, Atopcha, Gyraznoya, Munguchi, and Kurba. Other deposits, especially the Korotkov, 16 miles from the village of Krasny Yar, on the Chikoy River, and deposits along the Namama River, give promise, but insufficient prospecting makes estimates as to their tonnage impossible.

In Eastern Siberia and Maritime Province, the Verkhoyansk region, in the northeast, is the most promising, inasmuch as numerous discoveries of copper and polymetallic deposits have been made in recent years in the Orulgan Mountains. Copper deposits are also known in the South Ussurisk district at Djigit Bay.

Napoleon of the steppes—the man behind Kazakstan copper

Copper reserves of this Siberian region are given in Table V. However, only those deposits which have been more or less investigated have been considered.

Siberia's copper industry is not likely to attain great prominence for some years. The deposits to date are small and low grade. However, the possibility exists that larger copper deposits may be discovered in this vast region as time goes by. The eastern half is somewhat rugged and mountainous and certainly contains extensive mineralization. Water and timber are abundant in nearly all districts, but labor is scarce, transportation inadequate, and climate for the greater part of the year too severe and wintry to accommodate fruitful prospecting.

Transcaucasus Region

The Transcaucasus ranks third in copper reserves in Soviet Russia. Copper mining has been in progress there for many years, and the high-grade occurrences, with the exception of Zangezour vein deposits, have been practically exhausted. The bulk of the copper reserves now lies in low-grade orebodies. The following are brief descriptions of the copper districts in this region:

Located near the boundary of Persia and Russia, the Zangezour district contains the bulk of copper reserves of the region. The copper ore, chiefly chalcopyrite, occurs in irregular veins in andesite. There are two groups of veins, the Lenin and Shaumian, the latter being polymetallic. Porphyry copper deposits at Agarak, which make up the bulk of copper reserves, consist of disseminations of chalcopyrite, pyrite, and molybdenite in altered Tertiary granite rock. In addition, large dumps of ore exist which contain 1.0 per cent copper. A small concentrator and smelter now serve the district and construction of a 1,000-ton flotation mill is well under way.

In the Allaverdi district, the stock-shaped deposits, located near the station

Stream line freight transportation in Kazakstan. This view was taken between Spasski and Lake Balkash

Allaverdi, on the Tiflis-Erivan railroad, are practically exhausted. Further exploration of the Shamlug copper orebody, in this section, and deep-hole prospecting of the Allaverdi deposit, may prolong the life of the district. A small smelter serves the region, but construction of a larger plant is under way.

Certain other districts contain copper occurrences. The metal is found to a small extent (0.5 per cent) in the lead-zinc orebody at Sadon, in the Northern Caucasus. In Azerbaidjan copper occurs at Belokany and Trombon. In Georgia, deposits are known at Devdorak, Kakhetia, and Adjaria. On June 3, 1934, orebodies containing 1.5 to 3.0 per cent copper were reported at Uchancko, near Batum.

Copper reserves for the Caucasus region are given in Table VI.

The copper reserves of this ancient region are not likely to increase to great extent. With the extension of the railroad from Baku to Zangezour, the largest copper district in the area will be well served, but labor will be scarce.

In the Kola Peninsula

Copper-nickel deposits in the Kola Peninsula, which is beyond the Arctic Circle, are confined to the central part of the Montche tundra. The ores consist chiefly of pyrrhotite, pentlandite, and chalcopyrite in norite. In addition, copper and polymetallic deposits containing copper have been discovered at Novaya Zemlia, Vaigach, and at other points along the coast of the Arctic Sea. In Table VII no consideration was given these latter deposits.

As has been pointed out in the article "World's Copper Ore Reserves," which appeared in the *Engineering and Mining Journal* of October, 1934, Soviet Russia ranks fourth among the major earth divisions, following Chile, Africa, and the United States. Although the article mentioned, by Percy E. Barbour, is inexact as regards U.S.S.R., having failed to mention two substantial districts (Transcaucasus and Siberia) and a third, lesser, reserve on the Kola Peninsula, the ranking of U.S.S.R. as fourth in the world's major districts should remain correct for some years, as a spread of 15,000,000 tons exists between the third and fifth great divisions, the United States and Canada.

Analysis of Table VIII shows that approximately 65 per cent of the Soviet reserves is of possible (C-2) and probable (C-1) categories. Further analysis of grades, all Soviet deposits being considered, shows that 63 per cent of the reserve is ore containing less than 1.5 per cent copper. In view of the fact that 65 per cent of Soviet territory remains unexplored (in 1918, 89.6 per cent), discoveries of new copper deposits are to be expected from time to time. A veritable wave of geological prospecting is sweeping the country, at least 7,000 geologists and assistants now being assigned to exploratory work in its various ramifications. The accomplishment of increasing the reserve of copper from 517,000 tons in 1913 to over 16,000,000 tons in 1934 is indeed spectacular. On the other hand, some of the work has been of very poor quality. The Russian periodical "For Industrialization," on Oct. 27, 1934, states: "Some industries already face the exhaustion of mineral supplies on which they are dependent, notably certain copper smelters and coal mines. Sometimes much work is put on developing orebodies of too low quality for use; even a plant is put up without real knowledge of the ore it is to handle." Upon further exploration of the known orebodies, reserves of copper now credited to C-1 and C-2 categories are likely to be reduced, with the result that the total copper reserves, as shown in Table VIII, may not be affected greatly by the new discoveries.

Some idea of the expansion of the Soviet non-ferrous industry can be gained from the increase in capital expenditure in 1934 (280,000,000 roubles) over that in 1930 (108,000,000 roubles). In 1933, total expenditures amounted to 876,000,000 roubles. In the same year 314,100 workers and 12,724 engineers and technical assistants were employed. The average monthly wage of the employees of the non-ferrous industry increased from 87 roubles in 1930 to 173 roubles in 1934, but the cost of living has increased to a large extent in the same length of time.

Actual copper production (primary) has shown a slight increase during the decade, but total (primary and secondary) copper during the past five years remained near the 50,000-ton mark. Since 1929, milling facilities have been increased some 6,000 tons daily, smelter capacities have been increased to a large extent, and scores of mines have been reopened and exploited. The failure of the Copper Trust to speed up primary production more notably prompted Stalin, at the Seventeenth Party Conference held in January, 1934, to make the following severe prediction: "The non-ferrous industry did not

[1]Tables I and II are to be found in Part I, published in the December issue.

Table III—Copper Reserves of the Djezkazgan District

Name of Mineral Area	Number of Ore-bodies	Average Cu., %	Percentage of Total Ore Reserves
Kresto	10	1.82	41.8
Pockrovski	6	3.14	12.7
Petro	6	2.98	9.0
Annenski	5	3.70	5.5
Zlatoust	2	2.41	5.1
Nickolski	2	1.51	19.3
Taskuduk	3	2.91	0.7
Raimundovski	2	3.25	3.3
Spasski	1	4.0	1.2
Totals	37		100.0

Table IV—Copper (Metal) Reserves of Kazakstan and Central Asia

Metric Tons

Name of District	Tons of Ore	Average Cu., %	Category A + B	C — 1	C — 2	Total
Djezkazgan	113,550,000	2.07	1,033,600	394,400	922,000	2,350,000
Balkash	288,450,000	1.1	1,562,600	576,400	704,000	2,843,000
Boshtchekul	318,250,000	0.8	1,390,000	601,000	550,000	2,546,000
Spasski-Uspenski	9,200,000	2.5	60,000	45,000	125,000	230,000
Altai	74,815,000	0.9	113,000	87,200	466,100	666,300
Almalyk	201,000,000	1.1	133,000	980,000	1,100,000	2,213,000
Totals	1,005,265,000		4,292,200	2,684,000	3,867,100	10,848,300

Table V—Copper Metal Reserves of Siberia

Metric Tons

Name of District	Tons of Ore	Average Cu., %	Category A + B	C — 1	C — 2	Total
Total Western Siberia	18,530,000	1.85	32,900	54,300	255,700	342,900

Table VI—Copper Metal Reserves of the Transcaucasus Region

Metric Tons

Name of District	Tons of Ore	Average Cu., %	Category A + B	C — 1	C — 2	Total
Zangezour	4,575,000	4.0	35,000	63,000	85,000	183,000
Agarak	103,900,000	0.6	109,000	172,000	342,000	623,000
Allaverdi	2,660,000	2.0	3,800	3,200	45,000	52,000
Belokony Trombon	2,100,000	2.0	1,700	5,300	35,000	42,000
Devdorak Kakhetia	1,000,000	2.0	500	2,000	17,500	20,000
Sadon	4,400,000	0.5	5,300	9,400	7,300	22,000
Totals	118,635,000		155,300	254,900	531,800	942,000

Table VII—Copper Metal Reserves of the Kola Peninsula

Metric Tons

Name of District	Tons of Ore	Average Cu., %	Category A — B	C — 1	C — 2	Total
Montche Tundra (Totals)	1,760,000	3.0	8,000	5,000	40,000	53,000

Table VIII—Summary of Copper Metal Reserves in U.S.S.R.

Metric Tons

Name of Region	Tons of Ore	Category A—B	C—1	C—2	Total
Ural	245,980,000	1,229,000	763,400	2,038,000	4,038,800
Kazakstan	1,005,265,000	3,292,200	2,684,000	3,867,100	10,843,300
Siberia	18,530,000	32,900	54,300	255,700	342,900
Transcaucasus	118,635,000	155,300	254,900	531,800	942,000
Kola Peninsula	1,760,000	8,000	5,000	40,000	53,000
Totals	1,390,170,000	5,717,400	3,761,600	6,732,600	16,220,000

Table IX—Soviet Copper Production

Metric Tons

Year	*Min. Ind.* 1933 Page 715 Primary	*Min. Ind.* 1933, Page 127 (Taken from American Bureau Metal Statistics) Primary	Probable Actual Production† Primary	Secondary	Total
1910	.....	.....	22,700	.....	.....
1911	.....	.....	25,600	.....	.....
1912	.....	.....	32,200	.....	.....
1913	.....	.....	33,900	.....	.....
1914	.....	.....	32,500	.....	.....
1915	.....	.....	26,000	.....	.....
1916	.....	.....	21,400	.....	.....
1920	3,751	.....	....	.....	.....
1921	4,668	.....	....	.....	.....
1922	.....	.....	(*b*) 900	.....	.....
1923	2,710(*a*)	.....	2,700	.....	.....
1924	5,720(*a*)	.....	5,700	.....	.....
1925	12,578(*a*)	.....	9,000	.....	.....
1926	18,102(*a*)	10,624	18,100	.....	.....
1927	21,926(*a*)	13,597	22,000	.....	.....
1928	28,300(*a*)	*20,000	28,300	.....	.....
1929	30,000(*a*)	37,034	30,000	7,000	37,000
1930	50,500(*c*)	34,105	(*d*) 33,400	14,100	47,500
1931	31,090(*c*)	31,097	31,100	17,300	(*e*) 48,400
1932	32,000(*c*)	32,024	32,000	16,000	48,000
1933	.....	*37,500	32,800	12,800	45,600
1934	.....	.....	(*f*) 35,700	.....	(*g*) 53,000

Table X—Copper Imports Into Russia

Metric Tons

Year	Tons	Year	Tons
1910	6,547	1929	26,474
1911	7,819	1930	21,303
1912	7,032	1931	26,122
1913	6,132	1932	12,655
1914	12,852	1933	8,118
1915	42,442	1934	(*a*) 5,425
1916	62,458		
1928	28,410		

(*a*) First seven months of year.

perform its task during the First Five-Year Plan, nor did it perform it during the first year of the Second Five-Year Plan (1933). If it continues to lag behind in the future, it will become a brake on all industry. . . ." Production figures for the first nine months of 1934 reveal a failure of the plan set for the year, although they show an increase of 8 per cent over the record for 1933.

One may note with interest that against this small domestic supply of copper there are four or five fabricating plants in the U.S.S.R. (at Leningrad, Kalchugin, Moscow, Sverdlovsk, and Kiev) whose total input capacity is something over 250,000 tons per year. The Kiev mill is to be on a dual basis—25,000 tons of aluminum or 75,000 tons of copper shapes.

Indicative of the confusion surrounding records and reports of Russian production in general, and of copper in particular, can be cited the wide discrepancies appearing in the latest edition of *Mineral Industry* (for 1933), in which (page 715) under the statement "production of Russia, according to the best statistics available to *Mineral Industry*, is given in the subjoined tables," amounts of (primary) copper are shown for the years 1926-1932 that are at wide variance with figures appearing in Colonel Barbour's article on "Copper" on page 127 of the same volume. Colonel Barbour has used the American Bureau of Metal Statistics' figures. A comparison of figures on Russian copper production is presented in Table IX, which shows other irregularities as well in previously published figures. This table contains a somewhat carefully adjusted column, prepared by ourselves, showing what in reasonable probability Soviet production has actually been. Round numbers are used, as it is futile to seek anything closer than the nearest hundred tons when dealing with Soviet statistics.

Imports of copper into Russia during the same approximate period are given in Table X:

The *Mineral Industry* (1933) states: "The first stage of the enriching plant of the Karabash Copper Combine (Urals) has been put into operation. The daily capacity of the plant, which is the first of its kind in the Soviet Union, is estimated at 2,000 tons." Some confusion may exist as to the meaning of an "enriching plant," but this is a term commonly used among Russian interpreters for a flotation mill. The plant named is by no means the first of its kind in the Soviet Union, inasmuch as large flotation plants have been in operation for several years at Degtiarka, Pishma, Krasnia Uralski, and Kalata, in the Urals.

*Estimated. †Various published and private sources. (*a*) Fiscal year ending Sept. 30. (*b*) "Ten Years of Struggle for Non-Ferrous Metals," by V. S. Gulin, assistant director of Tvzetmetzoloto and member of the Supreme Economic Council, published (Russian) 1932 (375 pages), states that copper smelting in U.S.S.R. stopped from 1918 to 1922, resuming in the latter year. (*c*) Calendar year. (*d*) Fifteen months' year. (*e*) Russian published figures (*Pravda* and *Ural Worker*) and London *Economist* quote 75,000 tons total copper metal, which would indicate heavier secondary recovery than shown for 1931. Actual figures as to secondary copper during this year are difficult to determine, owing to extensive recovery from church bells handled partly by the refineries and partly by bronze and other plants. (*f*) Estimated at an 8 per cent increase over 1933, as per statements published in *Moscow News* and *Soviet Economic Review*. Actual production, however, judged from monthly figures reported in various Russian journals, may run several thousand tons below this Soviet estimate. (*g*) Estimated by "Za Tzvetnis Metalli" November, 1934.

Conclusion

Some have expressed the opinion that the Soviets may become an early competitor of other copper-producing countries in world markets. It can be safely asserted, however, that the conditions and facts being as here set forth, with an annual primary production not far from 30,000 tons for the past six years, despite strenuous efforts to increase it, and with the supply of scrap steadily diminishing, Soviet Russia will be for some time an importer of copper in large quantities to supply the huge demands of its industrialization program. The present decade, in short, should hold but little Soviet competition for the foreign copper producer. Years will pass in considerable number, if one may judge from the present rate of development of the Soviet copper industry, before the thousands of miles of needed railroad will be laid to the copper districts, and mills and smelters constructed, though undoubtedly surprising progress will be made. Moreover, should U.S.S.R. devaluate, stabilize, and place its currency on a foreign exchange basis, much of the Soviet ore reserve will be removed to an economic position that will preclude normal competition.

The physical characteristics and location of the copper mines of the Soviet Union in respect to supplies and market will always continue a heavy handicap in world competition. In all appraisals of industrial progress in U.S.S.R., one may well keep an open mind. The remote desolate wastes of Central Asia —where lie two-thirds of the listed Soviet copper reserves—are, after all, not much more inaccessible than were, not long ago, the resources of Central Africa, now offering supplies not unknown to copper circles on other continents. The slow tempo of current Soviet copper production is something of a menace to the industrial base of the nation and distinctly a challenge to the Kremlin. One is safe in taking the view that strong forces are being organized for the speeding up of this particular corner of the Soviet industrial picture and that this copper effort must and will be directed squarely at the Kazakstan and Central Asian "porphyries."

NEWS OF THE INDUSTRY

Mexico Imposes Higher Tax Levies On Silver and Copper Output

President Cardenas States Action Assures Country a Just Share in the Increased Profits of the Mining Industry—All Future Payments to Be Made in Mexican Currency Instead of American Dollars to Adjust Exchange Situation

RECENT changes in the mining impost law of Aug. 30, 1934, ordered by President Cardenas, increase production taxes on silver and copper, inasmuch as these levies must henceforth be paid in Mexican currency instead of American. Explanation was made that this action assures Mexico a just share in the increased profits of the mining industry and adjusts the foreign exchange situation, now at a ratio of 3.60 pesos per dollar, as compared with the normal two-for-one rate, as applying to these production taxes. The imposts are established with regard to the price of silver, as Mexico is off the gold standard, the decree explains. Payment of the taxes must be made on the basis of the following percentages of the market price of silver and copper:

Silver—Natural minerals, 6 per cent; concentrates, 5 per cent; precipitates, impure bars or mixed, 4 per cent; and refined, 3 per cent. When the New York price of silver, converted into Mexican money, exceeds 1.20 pesos per ounce, these taxes will be increased by 1 per cent per each 15 centavos or fraction thereof of the augmented price.

Copper—Natural minerals, 2.7 per cent; concentrates, 2.2 per cent; impure bars or matte, 1.7 per cent; and refined, 1.2 per cent. These rates apply when the price of electrolytic copper in New York, changed into Mexican currency, is 80 centavos the pound. There will be increases or decreases of one in 1,000 when this price rises or drops 3 centavos per pound.

The Ministry of National Economy announces that more than 10,000 men are now employed at a total daily wage of about 30,000 pesos (about $8,250, U. S.) in American Smelting & Refining's Santa Barbara, La Prieta, Parral, Tecolotes, and Santa Eulalia units; by San Francisco Mines; and by Cia. Minera Los Azules, all in Chihuahua. . . . Important gold-silver deposits have been discovered at La Noria, Mesillas, and Cerro del Toro, Sinaloa, the Ministry states.

Persons born in Mexico of foreign parents and Mexican women who lost their citizenship by marrying aliens, who have not taken steps toward retrieving or obtaining Mexican citizenship, are denied rights to obtain concessions to work either mines or water and mineral combustibles tracts, under amendments to the Nationalization Law of Jan. 20, 1934, ordered by President Cardenas.

An American syndicate is negotiating with owners of mining lands at Parrilla, Nombre de Dios municipality, Durango, for a long term lease of the property. . . . Preparations are being completed for resumption of work in mines at San Jose Lagarzona, Oaxaca, that were closed some years ago. . . . Contending that present operations are unprofitable and that large investments in explorations had negative results, Amparo Mining has asked the federal conciliation and arbitration board for authorization to suspend work in its mines at Etzatlan, Jalisco. . . . Golden Girl Mining, organized by American and Mexican interests, with a capital of 200,000 pesos (about $56,000, U. S.), of which William R. Hart is manager, is arranging to work 100 of the 408 tracts it controls in the El Fileno and Cerro Colorado zones, Huajicori municipality, Nayarit. The company plans to establish a 25-ton treatment plant next month.

Seventy-five carloads, each containing from 35 to 45 metric tons of ore, were shipped from Acaponeta and Huajicori municipalities, Nayarit, to smelters at San Luis Potosi last November. . . . Mining companies have become interested in gold deposits near La Bonancita, Sonora, that are being worked by numerous prospectors.

The following 1934 ore-production figures for the mining companies listed were recently announced by the government: Cia. Minera San Jose, 59,054 metric tons, averaging from 230 to 450 grams of silver per ton, from January to November; Cia. Minera Natividad y Anexas, operating at Natividad, Oaxaca, 144,026 kilos of gold and 7,493.8 kilos of silver, January to November; Cia. Minera La Herradura y Anexas, operating in the Pachuca zone, Hidalgo, 121,210 tons, ranging from 477 to 614 grams of silver per ton, in the first eleven months, during which period this company worked in collaboration with the Cia. Minera de Real del Monte y Pachuca; Cia. Minera Santa Teresa, for first eleven months, 16,047 tons, averaging 2 to 4 grams of gold and 1.87 kilos of silver per ton; Neg. Minera San Rafael y Anexas, for the first ten months, 113,597 tons, averaging 1.63 to 3.91 grams of gold and 344 to 402 grams of silver per ton.

●

Venerable Cornish Tin Mine Will Be Reopened Soon

The venerable Great Work tin mine, in West Cornwall, has been purchased from Wheal Reeth Tin, and funds are being provided by a new company to reopen the property after about 40 years of idleness. Great Work was one of the famous early producers of the Cornwall district. It appears to have been opened and worked quite extensively before black powder or other explosives were used, and its cost sheets still exist for as long ago as the 1750's—back to the time when mining captains worked for 40 shillings ($10) per month. This mine was finally closed down in 1902 because of a slump in tin prices. It is one of the properties that optimists on Cornwall's future have always predicted would again be an important producer.

●

Antamok Increases Capacity

Installation recently of a 200-ton Butters filter has enabled Antamok Goldfields, an important producer in the Philippines, to handle 450 tons daily. A 2,000-ft. tunnel being driven from the Gold Creek mine, near by, will be finished in about four months, and ore from this mine will be milled at Antamok, increasing the daily tonnage to 500 tons.

●

Namaqua Copper to Liquidate

Shareholders of Namaqua Copper have agreed to the winding up of the company, a special meeting held Dec. 7 so voting. The property in Italy, which it optioned last year, proved disappointing. All properties and other assets are to be liquidated.

● The Mojave area, Kern County, Calif., as seen looking northwest over the desert. Arrow points to the Silver Queen mine acquired by a group organized by Gold Fields American Development through the exercise of an option that involved $3,250,000 in cash payment and royalty. The recently formed operating company is Golden Queen Mining

Mojave District Retains Interest Of Western Mining Men

Silver Queen Moves Up a Peg to Become the Golden Queen When Gold Fields American Development Group Exercises Its Option on the Property—RFC Grants Consolidated Coppermines $3,000,000 to Erect Mill

CURRENT activities in the Mojave mining area and new developments at the Silver Queen mine, on Soledad Mountain, 7 miles south of Mojave, continue to hold the interest of Western mining men. In reply to an inquiry from *Engineering and Mining Journal* relative to the exercise of its option on the Silver Queen property, Gold Fields American Development has made the following statement: "We have pleasure in confirming to you that a group organized by The Gold Fields American Development Company, Ltd., subsidiary of The Consolidated Gold Fields of South Africa, Ltd., London, and including several British and American mining corporations, has exercised in the name of the Golden Queen Mining Company of Delaware its option to purchase the Silver Queen gold-mining properties near Mojave, Calif. The group has purchased these properties as an investment, and their management and development will be carried out by The Gold Fields American Development Company, Ltd."

United States Senator Key Pittman and associates have organized the Soledad Mojave Mining Syndicate to operate the Soledad Extension mine and near-by claims on Soledad Mountain that adjoin the Silver Queen. The claims were purchased recently from Burton Brothers and Bert Fisher, of Mojave. The company has retained the entire working crew at the mine, and operations have continued without interruption, with E. E. Whitely in charge. H. R. Van Wagenen, of Los Angeles, has optioned the Santa Ana and Starlight claims of the Grey Eagle-Elephant mines, owned by Jess Knight. Mr. Van Wagenen is reported to have let a contract for core drilling on the Starlight claim to Continental Diamond Drilling, of Los Angeles. Los Angeles interests headed by A. G. Keating and H. Hamond have acquired the Double Eagle group of claims near the Silver Queen and plan to start development at once. W. E. Trent and associates are reported to have purchased the Goat Ranch section adjoining the Roger-Gentry discovery at Neenach.

CALIFORNIA

● In the Jackson sector, Central Eureka Mining has recognized the miners' union and has resumed partial operation at its mine at Sutter Creek after a shutdown of nearly three months. The Kennedy and Argonaut mines, at Jackson, remain closed.

Operating three hydraulic giants, Igo Mining, at Redding, is moving about 1,500 yd. of gravel a day at the Piety Hill and Russell properties, in Shasta County, with 50 men employed in mining operations and on new construction. Water is purchased from the Happy Valley Company, which delivers it to an equalizing tank owned by the company. H. C. Crofoot is in charge of operations. Near Trinity Center, Shasta Hydraulic Gold is moving 2,000 yd. of gravel a day, with two giants in operation. After completion of a construction program, including the repair and building of flumes and ditches, and erection of a series of restraining dams, the two companies plan to increase production to 10,000 and 30,000 yd. of gravel a day, respectively. More than 100 men are employed by Shasta Gold, with mining operations and construction being directed by J. W. Crofoot, superintendent. Both projects are controlled by J. F. Stratton and associates, of San Francisco.

Management of Beebe Gold Mining, operating the Alpine and Beebe mines, near Georgetown, has passed to Alaska Juneau Mining, of which P. R. Bradley is president. The Hardinge-Hadsel mill is reported treating about 200 tons a day, about 35 tons of ore being received by truck from the Alpine mine. At the Beebe mine, development work on the 500-ft. level continues.

Great Northern Gold Mines has acquired the Hoge mine and other properties of Hoge Development, and is preparing for comprehensive operations. At present the Hoge mine, near Nevada City, is being worked by leasers, and the 75-ton mill is treating ore shipped from the Grass Valley Bullion mine, two miles south of Grass Valley. Arthur W. Hoge is president of the company, with offices at Nevada City.

The Bay State mine of West American Consolidated Gold Mines has been equipped with hoisting, air-generating, and other machinery, and development is in progress on the 300-ft. level. At the company's Amador Star mine, near by, drifting is under way on the 500 and 800 levels, and a raise has been started on high-grade ore, more than 150 ft. of which shows a streak of free gold. Both mines are near Nashville, and are to be connected by tunnels. The 75-ton flotation mill at the Amador Star mine is to be enlarged to 300 tons, and machinery required for the change is in course of erection. Arthur Hamburger is president of the company.

With a comprehensive investigation of one year's duration completed, Anglo-American Mining plans to erect a cyanide plant to re-treat the tailings dump at the Yellow Aster mine, near Randsburg, which dump is estimated to contain 2,500,000 tons. Construction of the first 800-ton unit is to start at once, and the firm of Hamilton, Beauchamp & Woodworth, metallurgical engineers, of San Francisco, has been retained to assist in the design of the new plant, the capacity of which is to be raised gradually to 1,500 tons a day. The company employs about 200 men at the Yellow Aster and Big Dyke

mines, with A. W. Frolli in charge of operations.

Fletcher Hamilton, former State Mineralogist, is reported to have taken over the Red Cross mine, 32 miles from Marysville, Yuba County. Early development of known orebodies and erection of a mill are planned.

Discovery of a new vein on the 1,200-ft. level at the Central mine, on Banner Mountain, near Nevada City, has been announced by Otto E. Schiffner, general manager, Lava Cap Gold Mining. The company also operates the adjoining Banner mine, where larger hoisting, air-generating, and electrical equipment was installed recently.

Mojave Smelting reports satisfactory operation of its new 25-ton smelter completed recently at Mojave, which is equipped to treat ores from the Mojave and adjacent mining districts. William McNiel is president, D. R. Laird, secretary-treasurer, and F. Cook chief engineer.

NEVADA

• Consolidated Coppermines, according to an announcement of R. W. Higgins, of Duluth, president of the company, has been informed by the RFC that its application has been granted for a loan of $3,000,000 to finance the construction of a mill to treat the copper ore that it is mining in the Robinson district. An additional $350,000 will be made available to the company for the erection of a power plant if this additional financing is desired. Construction of a selective-flotation mill 1,500 ft. west of the Emma Nevada shaft is planned. The plant will have a daily capacity of 8,000 tons.

Most notable of recent developments in Nevada, in point of measureable tonnage of pay ore and adequately financed provision for major-scale milling projects, are two enterprises in the Como district, in Lyon County, 12 to 15 miles airline south of the old Comstock lode bonanzas. The geology of the district resembles that of the Comstock: wide, quartz-filled fissures in andesite, the outcrops yielding rich gold ore to the "chlorider," and the water table marking, but varying in elevation in different veins, a pronounced delimitation between the zones of oxidation and sulphidation. Both projects have been financed in the Eastern states, Como Mines largely in New York and Stone Cabin Consolidated in Philadelphia.

Como Mines has completed development work through a long transportation and drainage tunnel and two laterals, at a cost of about $200,000, and is estimated to have considerably more than 1,000,000 tons of highly profitable mill ore above its adit level. Metallurgists are engaged in designing a mill, the first unit of which will be either of 300 or 600 tons' capacity.

In the northern section of the district, Stone Cabin has been treating 400 tons per day in its flotation mill and is providing additional equipment to meet the 500-ton capacity of its lately completed cyanide leaching plant. W. W. Charles, president, now at the mine from his Philadelphia office, states that his engineers, following an intensive sampling of surface ore in the massive outcrops of the Stone Cabin and Pony Meadows veins, are preparing specifications upon which contracts will be let to mine, by power shovels, a large tonnage of low-grade gold-silver ore that can be delivered to the mill bins by gravity at low cost. Two or three other projects of major importance may be started with the opening of spring, making Como the outstanding gold-silver district in this region.

Expansion of operations of Gold Circle Consolidated, at Midas, Elko County, is planned but apparently subject to reports of engineers lately in the district and known to be affiliated with important Eastern interests. The company's 75-ton cyanide mill has been running at only part capacity, on ore from the Elko Prince mine and from leases on company ground. Gold Circle Consolidated owns several mines in the district, none opened to appreciable depth excepting the Elko Prince, which has produced rich ore to a depth of 900 ft. None of these properties are adequately equipped, although ore of high grade has been opened in several of them.

Heavy storms have retarded work of Pardners Mines in its two ventures in Nevada: Buckhorn Mines and Dixie Valley. At the latter property, in Churchill County, E. A. Montgomery, who during the Bullfrog boom enlisted the interest of Charles M. Schwab in the Montgomery-Shoshone, has developed the most spectacular showing of gold ore known in many years to Nevada miners. He has been operating a 50-ton amalgamating and concentrating mill, drawing ore from a shallow tunnel. Pardners Mines took an option of purchase on the property about two months ago and undertook to sink a shaft near the footwall, but lately the miners have been driven out by a flow of hot water. Along the same side of the range are a number of hot springs.

• Plant of Idaho Maryland Mines At Grass Valley, California

• Above—Brunswick mine and mill. Ore-treatment plant, of 250 tons' capacity, includes twenty stamps and a complete flotation section. Below—New 200-ton flotation plant and 25-ton concentrate cyanide treatment plant. A 55-ft. Dorr tank at the flotation mill is seen in the foreground

Highly productive work of lessees at Rosebud, in the northern part of Pershing County, has been halted by an action brought against Sam Willig and "Red" Taylor by former partners in the "Ragged Six" lease on the Brown Palace property. Two years ago six impoverished prospectors joined forces in working the lease and made several shipments, but abandoned the ground when the ore pinched out. Willig and Taylor last summer returned to the tunnel, and within four months shipped high-grade ore to the value of $50,000 or more, with the result that their former partners are now seeking an accounting and part of the proceeds. The Ramsey-Stoneback lease also has been forced to suspend production.

ARIZONA

• Arizona gold production passed the $5,000,000 mark in 1934, equaling, in value, that of the total output for the three preceding years. Only California, South Dakota, and Colorado reported greater production in the United States. Byproduct gold from copper ores remained at a low figure. No new properties of large size were brought into production. The increased output resulted from greater activity at the producing mines, reopening of old properties, and development of a number of small mines.

Arizona Copper Belt Mining, at Constellation, has completed a 30-ton mill. The crushed ore goes to a 100-ton bin ahead of a rod mill. Mill discharge, at 40-mesh, passes through an impact amalgamator to a concentrating table, which makes finished concentrate and tailing and a middling product, which is treated in a two-cell flotation machine after thickening. W. J. Dilthey, president, superintended the construction of the mill, designed by W. J. Thomson, representative of W. W. Gibson Company. Two vein systems cross the property, the copper-silver veins striking southeast-northwest and the gold veins, east-west.

Octave Exploration is working the Bishop group of claims, under the direction of C. T. Sullivan. A road is under construction from the main highway. W. F. Groves, of Prescott, has received the contract to sink a 300-ft. shaft.

Pioneer Gold Mining has completed the mill at the Pilgrim mine, near Chloride. A primary crusher, at the gallows frame, crushes to 3 in.; a Kennedy-Van Saun secondary crusher in the mill delivers a ¼-in. feed to a Hardinge ball mill. The mill discharge is floated in a Denver unit cell before going to a Dorr rake classifier that operates in closed circuit with the ball mill. Classifier overflow is floated in a six-cell Denver Sub-A machine. Concentrate is cleaned in a four-cell Kraut machine. Tailing is scavenged in a six-cell Kraut. Scavenger concentrate and cleaner reject are returned to the ball mill, as is the amalgamation plant reject from the treatment of the cleaner concentrate. Carlton Bray, general manager, is assisted by M. C. Richardson, mine superintendent, and James A. Potter, mill superintendent, who directed the construction of the plant.

Margarita Gold, at Ruby, is milling 1,000 tons a month. Mining is by tunnel and open pit; treatment by cyanidation.

Nellie Meda mill of Wenden Copper, Yavapai County, completed and tested last July, has been inactive owing to drought conditions. Adequate water supply has been encountered at a depth of 580 ft. in No. 3 well. Ned Creighton, president, reports that changes since the test run should result in improved metallurgy.

Owl Mining is sinking a 300-ft. shaft. Midnight mine is unwatering and retimbering. Both properties ship to the Tom Reed mill, at Oatman. Derrick Mining, near Oatman, has advanced its main tunnel 800 ft. and is drifting to encounter the junction of the Moss vein.

Commonwealth Development, at Pearce, is reconditioning the cyanide plant to handle ore developed in the mine during the past year.

Adams mine, in the Katherine district, has completed retimbering of the main shaft. Ore developed prior to a fire several years ago will be shipped to the Gold Standard mill while exploratory work is carried on in new ground.

Patience mine, near Phoenix, has let a contract for the installation of a 25-ton Stoneham amalgamator.

MONTANA

• Inspiration Gold Mining, operating the Bielenberg & Higgins property, at Bear Gulch, near Twin Bridges, Madison County, has been milling 100 tons of gold ore per day in its new plant. The property is equipped with modern machinery, driven by electricity obtained from the Montana Power Company. Angus McLeod, former sheriff of Silver Bow County and for many years general mine superintendent of Butte & Superior Mining, is manager.

Anaconda Copper Mining is said to be interested in the operations and examination of three gold properties in Montana, one in Madison County, one in Deer Lodge County, and one in Beaverhead County.

After making several improvements in its milling plant, Butte Highlands Gold Mining is ready to resume operations, in the Highlands Mountains, about 18 miles south of Butte. George Eckerle, well-known Butte mining operator, is manager. The main orebody contains free gold in limestone. A few months ago a transmission line was built to connect with the line of the Montana Power Company at Janney substation, on the line of the Milwaukee railroad. County commissioners have been petitioned to build a better and shorter road into the district.

The Mining Association of Montana is introducing two bills into the State Legislature, now in session at Helena, according to Carl J. Trauerman, Butte, president of the organization. One bill is seeking to liberalize the present law on leasing and prospecting State-owned mineral land and the second bill is to prevent high-grading in the precious-metal mines. Charles E. Pew, Helena attorney, is head of the association's legislative committee.

MICHIGAN

• Calumet & Hecla Consolidated Copper has moved equipment and supplies to the Ropes mine property, north of Ishpeming, preparatory to starting exploration for gold. The company recently purchased the controlling interest in Ishpeming Gold Mining. A small crew of men is putting up a covering for the shaft and building supply and engine houses. The shaft will be dewatered while the building work is in progress, two electric pumps having been shipped to the property for that purpose. According to estimates, about 20,000,000 gal. of water will have to be removed from the shaft, which is 850 ft. deep. A power line already extends to the mine.

Several gold companies flourished for a brief time near Ishpeming 40 or more years ago, but were forced to quit because of various unfavorable circumstances. Interested persons believe that modern methods would make operation of some of these mines successful and that further exploration of the field would lead to important discoveries. The Ropes gold property, now to be worked by Calumet & Hecla, had a gross yield in gold of more than $600,000 when it was operated nearly 50 years ago. The company plans to resume operations with a view to disclosing veins carrying gold in paying quantities and, perhaps, to explore the field further.

In research work at the Michigan College of Mining and Technology, at Houghton, one of the methods proposed as a solution of the problem of the successful mining of the low-grade lodes of the Michigan copper district is to discard, early in the process of production, a substantial part of the rock broken in the mining operation. The successful use of heavy suspensions in iron-ore testing suggested their use for making a separation of the copper rock, and preliminary tests on rock from one of the lodes proved so encouraging that further work on that rock has been conducted, with even more satisfactory results.

On the basis of this testing the statement can be made that from 50 to 80

per cent of the rock broken in mining contains so little copper that to transport and mill it under the present price level of the metal does not pay. In many instances, however, a sufficiently accurate separation of this worthless rock from the copper-containing rock can be made by means of heavy suspensions, such as are being tested. The use of these heavy suspensions involves such a simple flowsheet that it could be placed in the mine or at the shaft or at any other point in the process where economic considerations dictate. Cost of operation is low. Plans are being made to investigate all lodes in the district; also, amygdaloid sands and copper slags.

PHILIPPINES

• A new mining record for the Philippine Islands was made by Balatoc Mining last November, when it produced gold and silver valued at more than 1,050,000 pesos ($525,000)—the highest monthly production ever made by any mine in the district. Tonnage milled during the month was 19,225. The increased production of Balatoc was not the result of any sudden change, but followed a steady and substantial development program that was carried out throughout 1934. During 1933 Balatoc treated 148,732 tons of ore having an average value of 46.02 pesos a ton, the gross value being 6,844,939 pesos. Figures for 1934 will be much higher, and when present plans for increasing the mill capacity are carried out, expectations are that the monthly production will be close to the million-dollar mark.

Suyoc Consolidated is expected to become a gold-bullion producer early in 1935. Construction work at the company's properties, about 95 km. north of Baguio, was begun early in 1934, and concentrate valued at about 175,000 pesos was produced during September, October, and November. Plans at the start were to ship this concentrate to the smelter at Tacoma, Wash., but consulting engineers for Marsman & Company, which has an operating contract with Suyoc, have worked out an efficient and economical treatment. A combination flotation-cyanidation mill is in operation, and a refinery was completed in December. R. W. Crosby, formerly of the staff of Itogen Mining, is general superintendent at Suyoc. About 800 men are employed at the mine, and a mill capacity of 150 tons daily is being handled, with an expansion to 200 or 250 tons planned as soon as final experimentation is finished.

The beginning of 1935 saw two new cyanide plants come into operation. Demonstration Gold Mines started its 100-ton mill shortly after Jan. 1, and Gold River Mining its 175-ton plant about a month later. Richard E. Lile is general superintendent at Demonstration, and James E. Moore at Gold River.

Enough ore to run its mill for ten years has been blocked out at the Antamok Goldfields Mining properties, with a possible tonnage of 1,300,000 tons. The 463 vein on the 830 level was cut in November, uncovering an orebody about 66 ft. wide. The highest monthly production and highest tonnage milled were reported at this mine during last November, with an 11 per cent increase in tonnage milled, to 9,300 tons, and a 27 per cent gain in bullion produced, to 140,388 pesos.

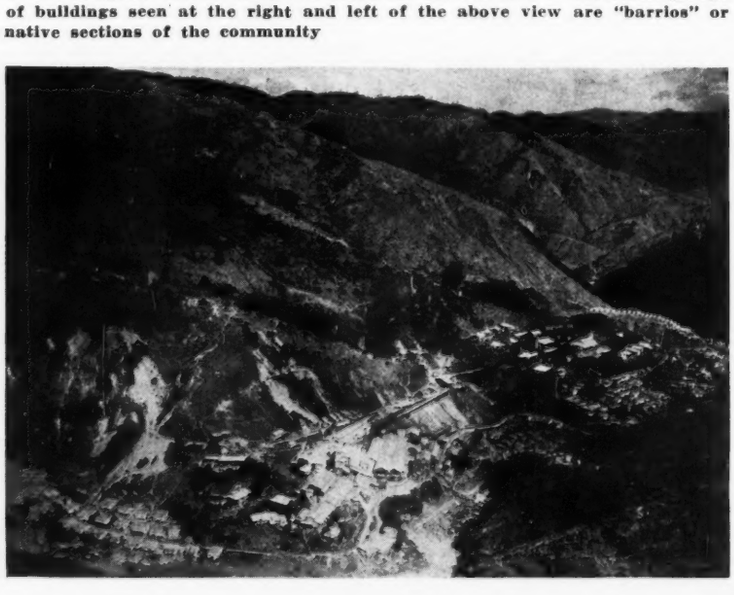
Itogon Mining has declared a 100 per cent stock dividend, and has raised its capital stock from one to two million pesos, changing its par value from one peso to ten centavos. Under the direction of James B. Stapler, general superintendent, the Itogen mine and mill has become one of the most efficient plants in the Islands. Itogon production has come up steadily, and its efficiency with it. New records were made at Itogon during October, when 9,215 tons of ore were milled, with a recovered value of 13.86 pesos a ton for a production of 217,842 pesos, and an extraction of 91.5 per cent.

Marsman & Company, a corporation that holds supervising managing contracts with six mining companies, namely, Itogon, Suyoc Consolidated, San Mauricio, United Paracale, N. E. Placer Syndicate, and North Mindanao Syndicate, has reorganized, increasing its capital stock to 300,000 shares of non-par value. Of this stock, 145,000 shares have been issued and fully paid, and 75,000 shares of non-par value were offered for public subscription. The company's staff of consulting mining, metallurgical, and construction engineers includes J. O. Greenan, J. O. Enberg, J. B. Stapler, Alf Welhaven, George W. Kerr, and J. E. Fyfe.

The first all-flotation plant in the Philippine Islands is being installed at the United Paracale Mining property, in the municipality of Paracale, Camarines Norte, Longos group, about 250 km. southeast of Manila. The mill was designed for a capacity of from 100 to 125 tons a day, but the installation is being made so that a capacity of 250 tons can be brought about easily, with a minimum of expense for the additional machinery. J. O. Greenan, consulting engineer for Marsman & Company, which has an operating contract with Paracale, is supervising the construction of the new plant.

Ore of good grade has been mined during the course of development, and has been placed on an ore dump between the mine and mill pending the completion of the latter. The mine, when it comes into production early this year, will be the only producing lode mine south of Manila in the Island of Luzon, and one of the few producers outside the Baguio district.

• Looking down from the Benguet hills on to the buildings of Benguet Consolidated Mining, along Antamok Creek, in the Philippine Islands. Structures of the company extend along the creek for several miles. Scattered groups of buildings seen at the right and left of the above view are "barrios" or native sections of the community



KAN.—OKLA.—MO.

• Unwatering of the old Oronogo section of the Tri-State district, an area that has been dormant for almost twenty years, was started last week. Frank Childress and associates, who unsuccessfully endeavored to obtain a Government loan for the unwatering and construction of a mill in that old section of the Missouri field, are backing the new venture.

A 14-in. five-stage Pomona pump has been installed at what was known as the Waring shaft, just south of Oro-

(Continued on page 98)

NEWS FROM WASHINGTON

By Special Correspondent

THE federal Government, like all Gaul, is divided into three parts. Cæsar told us about Gaul; and in January the Supreme Court reminded us about the federal Government functions. But the Court in its pronouncement was careful to limit its overruling of administrative action on petroleum by such phraseology as not to set fire to the whole oil-control program. It was much as if lightning had struck a well-grounded storage tank: quite a flash, but no fire.

Congress is thus cut loose from the Presidential apron strings and told to go out and act the manly part, legislating as intended by the fundamental law of the land. This does not mean that Congress may not take legislative recommendations, almost legislative orders, from the White House. But it does mean that when Congress gives power of administration to the President, it must be explicit as to the purpose, and in some respects as to the method, by which the Executive is to function. No longer can it simply abdicate its legislative functions and pass over blanket jurisdiction. At least the semblance of tri-part government is thus restored.

Social Legislation

MORE exact legislation may be expected. In some respects there will be legislation which the President does not want, notably granting of some bonus money (perhaps a billion dollars), possible defeat of the St. Lawrence seaway, and probably larger and earlier old-age annuities and unemployment insurance. In other words, Congress will want to spend more money than the President and will insist on doing so in three ways: for veterans, for the aged, and for the unemployed of the future as well as those of the present. But Congress will not generally get far off the Administration reservation.

The President's social legislation plan submitted Jan. 17 makes clear why Miss Josephine A. Roche was named recently to a high post in the Treasury Department. She was undoubtedly selected to supervise the enlarged Public Health Service organization which is contemplated. And it is more than likely that the new organization will develop much enlarged activities in industrial health and worker welfare. For the mining industry this means increased attention for such subjects as silicosis, mining hazards, and possibly even mine-community health and welfare problems.

This little-noticed public-health phase of the New Deal program will require relatively small appropriation, $2,000,000 or $3,000,000 per year. But a few zealous investigators in these fields may create more than proportionate industrial problems. If the highly commendable professional attitude of the Public Health Service is retained, industry has nothing to fear from more aggressive tactics. But if this is supplanted by the professional reformer type of investigator, unfortunately more common in the Department of Labor, anything might happen.

Mine Securities at S.E.C.

REGISTRATIONS last year of new security issues at S.E.C. for the extractive industries were for approximately 80 concerns, which issued in excess of $23,000,000 of new securities. Mining-company loans formed the bulk of this business, with gold-mining enterprises representing the vast majority of the total number of companies involved.

New regulations regarding security registrations issued during January by the Securities and Exchange Commission will, it is hoped, gradually reduce the difficulty of further industrial financing. However, there is no relaxation of the fundamental requirement that there must be included a complete disclosure of all pertinent information by which the desirability of a new security may be judged by the prospective purchaser. Companies filing registration certificates are, therefore, required to include complete geologic and mining-engineering information such as would be necessary for decision by a competent commercial bank if it were asked to purchase the new securities.

Expectations are that the reports of technical men made a part of the registration filings will be just such documents as responsible consulting engineers would furnish to their banking or management principals with respect to like enterprises. Unfavorable, as well as complimentary, items of fact bearing on each situation should by all means be included, as excessively commendatory reports may actually be regarded with greater suspicion than those of more conservative form and nature.

Mining-security registrations recently received have related almost altogether to gold-mining enterprises. Official Washington, so far as it is interested in this matter, would like to see a wider spread of new security issues. Such expansion of financing would be regarded as a definite indication of favorable trends in new industrial development. Officials, of course, deny that the complexity of the registration procedure is the real cause of damming up the flow of new commercial paper. There is probably more truth in this denial, since the simplified procedure was recently announced. However, the task of successfully and promptly prosecuting a case before S.E.C. still remains one demanding real legal, accounting, and technical ability.

Future of NRA

LATE January opinion in Washington indicates mere renewal of NRA for another year or two under substantially the present law. High authorities would much prefer to enact a permanent law, but they find even within the councils of high officialdom such diversity of opinion as to make any crystallization of ideas on revision difficult if not impossible.

Unless the President decides most of these questions personally, there can be evolved little in the way of a central forceful plan. The President may think this expedient because he knows that permanent reform must be initiated and legalized before recovery makes industry too untractable. On the other hand, the President has plenty of more difficult and more pressing tasks. He may find it expedient, therefore, to postpone NIRA revision another year. He is probably safe in assuming that there will be plenty of unemployed in 1936 to make reform still good politics at that stage. In fact, some keen political interpreters in Washington already say the President and his political advisers are worrying about the short time before they must face another election campaign—worrying because there are still ten million unemployed, quite a load to drag through another election.

Mining Loans

AT THE END of January, 145 formal applications for mining loans had been filed with the Reconstruction Finance Corporation. Of that number 100 had been thoroughly studied by the mining engineers of the Corporation's staff. Out of the 100 it was found that only 10 apparently came within the act. In most instances applicants either fail or are not in a position to establish that they have blocked out ore of known value.

During the month examinations of three mining properties were completed. These examinations were made by engineers residing in the locality,

familiar with local conditions. In each instance the local engineers quoted very reasonable prices for their work and showed every desire to cooperate with the Corporation. In one instance the engineer found that the work was not as extensive as he had anticipated. As a result he rendered a bill for a lower amount than had been approved. In retaining these engineers the RFC requires the submission of an estimated fee. The estimate then must be approved by the applicant, who then makes a deposit with the Corporation sufficient to cover the examination cost. A definite decision has been made that any expense in connection with the dewatering of mines must be borne by the applicant.

Prices

IF NIRA is extended for a year in a form more or less "as is," then there will not be any need for working out by law the price-control problems which occasioned so much oratory at NRA hearings in January. The only thing proved at those hearings was the continuance of highly diverse opinion within every division of society.

Price control is generally recognized as peculiarly important for the natural-resource industries. Hence even though the trend away from legalization of price control continues, there is not much prospect that minerals, metals, or mineral fuels will be compelled to drop this vital part of their code activity. Even Senator Borah's leadership of a group which would restore free competition and strengthen the anti-trust laws cannot upset the prospects for certain price stability aided with federal control.

The Supreme Court decision on validity of the gold clause of contracts (not announced at date of writing) is not likely to occasion any great permanent price effects. This is true whether the decision be favorable or unfavorable to the Government in its defense of the gold-clause repudiation. If the Government should lose, it has a half-dozen means for escape from the "chaos" which has been so glibly predicted by speculators who wish to manipulate security and commodity markets.

T.V.A. Starts

SINCE Thanksgiving week Tennessee Valley Authority has been making superphosphate at its new fertilizer plant at Muscle Shoals. It is being manufactured from phosphoric acid produced in remodeled electric furnaces of the old ammonia works. Phosphate rock is coming from near-by Tennessee areas.

Budget requests to Congress include funds for a proposed conversion of two additional electric furnaces and the building and operation of a commercial-size blast furnace. The requested budget provides for a little more than $4,000,000 total as the gross expenditure in the fertilizer program during the fiscal year 1936. This includes extensive research on coal processing and chemical engineering and metallurgical studies. Estimates also provide a new field washing plant for phosphate rock. Among the mineral and metallurgical proposals is that of development by T.V.A. of local supplies of chromite, manganese ore, and other small ore deposits which it is hoped by the Authority can be operated with local part-time employment.

All of the operations mentioned in the foregoing are contingent not only on Congressional appropriation, but also on the outcome of the court cases which attack T.V.A. on Constitutional grounds and seek to prevent continued commercial operations of any sort, especially those relating to power. An important test case scheduled to be argued at the end of January, or one of the other two important policy-making court cases, is bound to go to the Supreme Court before anyone can tell with finality what mining, manufacturing, or power rights T.V.A. really has.

Labor Costs

ALL Washington factors continue to advance the unit cost of productive labor. Only in the President's message promising work-relief wage rates below those of industry is there any evidence of a relaxing of the pressure for higher wages. The recent NRA ruling which requires management to pay stand-by labor holding itself available by request, but not working, is but one of the straws in the wind. Prospective unemployment insurance and retirement annuities have a like influence, but they will be planks in a hurricane, not straws in a wind.

All these influences prospectively add to the unit cost of minerals and metals. The only management answer is mechanization. The higher the percentage of the total cost which goes to labor, the more important is the mechanization trend.

The A. F. of L. is one division of labor which does not put itself on record as against mechanization. But A. F. of L. is weaker today in Washington than for some time past. Just now it is struggling with internal dissension due to a split-off of twelve construction-industry unions. Leaders of labor are, of course, worried privately. Wiser industry leaders would be equally concerned if they thought this meant a collapse of the more conservative labor leadership and transfer of power to untried, allegedly irresponsible leaders. Those best informed in Washington ways do not believe this latter course likely, as it would weaken labor's cause at the White House. That consideration is, of course, much more important than the nominal effect in Congress.

Heavy Goods

OFFICIAL Washington is just about ready to accept the conclusion that recovery must come by industrial reemployment based on confidence in long-time developments. This explains the wooing of Business by the Administration. Business is quite willing to be courted but does not care for the handcuffs of intimate Government participation in new projects.

The proposed work-relief appropriation of $4,000,000,000 gives the President more money to allot, largely as a palliative with respect to unemployment. Originally it was planned also to give the President authority to extend present alphabetic agencies through June, 1937, to reorganize the Government, and to extend and modify its functions almost without limit. This sort of dictatorship authority, if granted, would probably create more industrial headaches of uncertainty than the appropriations can relieve.

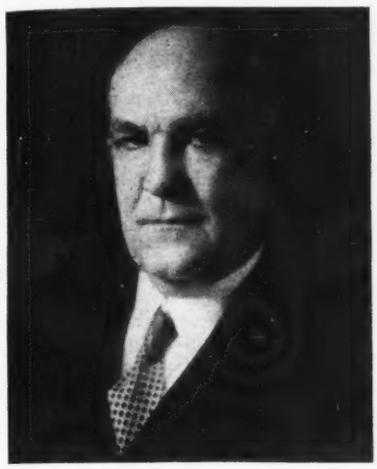
Despite all these disturbing factors, business is definitely better month by month. Heavy industries are at last beginning to feel clearly some of the stimulus. New railroad developments, naval armament programs, aircraft expansion, and housing, each contributes a bit to the aggregate. Estimates, believable and as impartial as any can be, suggest that 1935 will, therefore, be 10 or 15 per cent better for heavy industries than last year. Mineral industries should benefit in at least equal ratio.

Modernization

THE proverbial celluloid dog has a much better chance of survival than the court petitioners have with their request for $1.69 worth of currency for each gold dollar "due" them. As a matter of fact, it is possible that the President during this calendar year will move gold to the full legal limit—that is, to double its pre-depression value. He may have to do this in order to secure some more profits with which to pay the veterans' bonus and care for other burdens. Such a move is, indeed, more likely than the use of silver profits for bonus paying, as proposed by Senator Pittman.

Perhaps most encouraging of all is the present indication that Washington will look with favor upon modernization programs. Definite official encouragement is being given to the Association of American Railroads' plan for new technologic research. Talk in other quarters no longer discredits modest labor-saving developments. There is even some willingness to allow expansion of productive capacity under codes which require permits for new plant facilities of this sort.

"Bigger and Better" A.I.M.E. Meeting Indicated by Program



H. A. ("CHIEF") BUEHLER
President-Elect

Annual Gathering of Mining and Metallurgical Engineers, to Be Held Feb. 18-21, Promises to Surpass Former Meetings in Many Respects—H. A. ("Chief") Buehler, President-Elect —George C. Stone and James MacNaughton, Medalists

WELL-ROUNDED and holding promise of good "drawing power" is the program for the forthcoming annual meeting of the American Institute of Mining and Metallurgical Engineers, to be held in New York on Feb. 18-21. Besides the usual technical sessions, a most interesting general session is scheduled for Tuesday afternoon, Feb. 19, when C. K. Leith, chairman of the National Planning Committee for Mineral Policy, will speak on "Mineral Policy for the United States." John Wellington Finch, director of the United States Bureau of Mines, will preside at the session, and, after Mr. Leith's address, an open discussion will follow on economic phases of the mineral industries. Included among a number of executives of leading mining companies that have been invited to address the meeting informally are Albert E. Petermann and E. J. Cornish.

Two new sessions, introduced last year for the first time, will be continued this year, owing presumably to the wide attention that the two subjects involved are attracting—namely, application of the airplane in mining and dust hazards. At the aviation session, to be held Tuesday morning, Feb. 19, C. W. Poy will describe his parachute method of delivering dynamite and diesel engines from airplanes to an isolated gold-mining property in Alaska; the aid rendered Idaho's mining industry by the State's Department of Aviation will be related by R. L. Dean, of Shoshone; D. E. Grant, of Pan-American Airways, will show how the commercial air lines serve the mining industry; geological applications of the airplane in dam-site location will be I. B. Crosby's subject; and Carl O. Lindberg will bring up to date the "dredging-flying" record of that progressive New Guinea enterprise—Bulolo Dredging. And that program, one would presume, should hold the attention of all the air-minded.

The dust counters, phthisis experts, and others will convene Monday afternoon, Feb. 18, to hear D. E. Cummings, of the Saranac Laboratory for the Study of Tuberculosis, outline what comprises good practice in combating dust hazards associated with mining operations; Dr. R. R. Sayers, of the Public Health Service, Washington, D. C., will discuss the prevalence of anthra-silicosis among hard-coal mine employees; some effects of the inhalation of small particles of asbestos will be described by Dr. A. J. Lanza, of the Metropolitan Life Insurance Company; use of equipment designed to prevent dust produced by rock drills from contaminating air breathed by workers will be discussed by R. J. Mechlin, division manager of the St. Joseph Lead Company, Edwards, N. Y., and Theodore Hatch, of the Harvard School of Public Health, Boston, will present some fundamental data pertaining to mechanical dust traps. At a session on health and safety, scheduled for Wednesday morning, Feb. 20, Evan Jones will discuss handling of explosives, and W. B. Hillhouse the safe transportation of men.

A summary follows of the sessions of the meeting that will be of particular interest to the members of the metal-mining industry.

Summary of Program

Monday, Feb. 18:

Morning—Mining Methods; Eastern Magnetite Mining and Milling Methods Committee; Non-ferrous Metallurgy.

Afternoon—Health and Safety in Mines; Milling Methods; Non-metallic-Minerals; Geophysical Methods of Prospecting

Evening—Institute Dinner-Smoker

Tuesday, Feb. 19:

Morning—Aerial Transportation; Committee on Mineral Economics; Milling Methods; Mineral Industry Education Division; Geophysical Methods of Prospecting

Afternoon—Milling Methods; Federal Government and Mineral Industries

Evening—Informal Dance

THE MEDALISTS

Left—
GEORGE C. STONE
James Douglas Medalist

Right—
JAMES MACNAUGHTON
William Lawrence Saunders Medalist

Wednesday, Feb. 20:

Morning—Health and Safety in Mines; Non-metallic Minerals; Geophysical Methods of Prospecting.

Afternoon—Mining Methods; Ground Movement and Subsidence; Non-metallic Minerals; Geophysical Methods of Prospecting

Evening—President's Reception and Dinner Dance

Thursday, Feb. 21:

Morning—Mining Geology Committee and Society of Economic Geologists

Afternoon—Mining Geology Committee and Society of Economic Geologists

Evening—Society of Economic Geologists Dinner

• Operators of Seal Harbour Gold Mines, Goldboro, Nova Scotia, are sinking the Dan shaft, surface plant at the top of which is shown above, to a depth of 300 ft. Former owners of the property took out only the high-grade streaks from the substantial ore deposits of this mine. The remainder of the deposit, up to 60 ft. wide, is payable ore

World Copper Discussions Direct Attention to Canadian Mines

Position of Dominion Base-Metal Producers Strong But Constitutes Element Of Weakness and Uncertainty in Proposals for Regulation of the Industry—Excellent Gold and Nickel Markets Influential Factors

THE PRESENT attempts to regulate the world output and price of copper bring to the forefront once more the position of the principal Canadian base-metal mines, which constitutes a decided strength so far as the individual mines are concerned but injects an element of weakness and uncertainty into the proposals for regulation. By far the larger part of the Dominion's base-metal output comes as a byproduct, mainly of the precious metals and nickel. The present excellent market for gold (the predominating precious metal in question) and for nickel provides a strong inducement for the companies concerned to keep up their combined output of base and precious metals even at the cost of continued low prices for copper, lead, and zinc. Canadian nickel mines, for instance, produce two pounds of copper for each pound of nickel, and last year's output of nickel therefore involved two-thirds of the Dominion's copper output. The rapidly expanding market for nickel will therefore provide, of necessity, a still larger amount of copper during the present year.

Similarly, Noranda, whose principal product originally was copper, is treating ore and concentrate with a maximum of gold and a minimum of copper and cannot further curtail its copper output without impairing seriously its income from gold, now the major product. The position of the Sullivan mine of Consolidated Mining & Smelting is much the same, with zinc and lead substituted for copper and with a preponderance of silver over gold. The status of Flin Flon or Britannia or Anyox is not so clear-cut, but to continue operations at full capacity while gold remains at $35 is still decidedly to their advantage. Thus, apparently, it will be much simpler to effect a restriction in the large copper mines in Rhodesia and Chile, where output has recently been largely increased, than in Canada, where the increase has been comparatively small.

QUEBEC

• The difficulties of exploration in the eastern end of the Quebec gold belt are well exemplified in the instance of Lamaque, subsidiary of Teck-Hughes. Extensive surface showings with high values but erratic distribution were discovered ten years ago. These were examined on the surface and by diamond drilling by a long succession of engineers, all of whom were discouraged by the irregularity of the values. Only the success of the Siscoe mine, in the same area and with a somewhat similar problem, put the Lamaque deposits on the market again. Teck-Hughes has spent more than $1,500,000 on the property, and the management is sufficiently satisfied of the merits of the mine to put up a milling unit, now under construction, of 225 tons' daily capacity, with a view to a subsequent expansion when more is known about the ore. Exploration to a depth of 700 ft. has shown numerous flat-dipping lenses, disposed in irregular fashion throughout a zone in the granodiorite.

ONTARIO

• McKenzie Red Lake has just put in operation its 125-ton cyanide mill, which is designed to permit doubling this capacity if mine development should warrant it. A recent company report showed 97,900 tons of developed ore averaging 0.437 oz. across a narrow stoping width, down to the 350-ft. level. A level at 450 ft. now being opened shows this grade or better. This, the second mine to be established in the Red Lake area, differs essentially from the Howey in having a well-defined vein of comparatively small size and high grade, in contrast to the dike-like structure of Howey's orebody. The same hydro-electric plant serves both mines.

After ten years of search for the tvpe of orebody that is characteristic of the neighboring McIntyre and Hollinger mines, Coniaurum is meeting with notable success. Last year, treating 380 tons a day of ore from its comparatively small veins, it averaged $7 recovery. During recent months, a new vein system, No. 15, opened from the 1,000 to the 2,000-ft. levels, has disclosed ore of double this grade in substantial quantities. This lies adjacent to the eastern end of the Pearl Lake porphyry mass, in a position similar to the vein systems that have been of such great importance to the Hollinger and McIntyre mines during recent years. A report to shareholders covering the period to Nov. 30, last shows 1,465 ft. of high-grade ore exposed in this new vein system on these levels, averaging 6.8 ft. in width.

Details of Ontario's gold output for 1934 show that mine output is being expanded throughout the province and that the larger mines are conserving their high-grade ore by milling much material that formerly was unprofitable. The output of $70,063,046 from 6,375,867 tons of ore is 47 per cent in advance of the 1933 total of $47,872,532 from 5,607,395 tons. Kirkland Lake camp, with $34,007,870, led Porcupine by a million dollars. Ten mines in northwestern Ontario, principal among them being Howey, yielded $3,020,502, double their output of the previous year.

Little Long Lac's new mill is running nearly to its capacity of 200 tons on ore averaging close to an ounce per ton. Development on the fifth and sixth levels has been started, and the ore so far disclosed is at least up to mine average, and probably better.

Sturgeon River Gold has developed its original north-south vein sufficiently

to indicate that it is one of those rare occurrences that combine ore of high grade and consistent values. Surface work has disclosed the high-grade ore in this vein for a length of close on 1,000 ft., the values being measured in several ounces per ton across widths from 6 to 12 in. Diamond drilling at shallow depths has also given these values, and the latest hole at 180 ft. depth shows an improvement on the average. Sturgeon River Gold is controlled by Coniagas, which, for ten years since its property at Cobalt was worked out, has conducted a consistent campaign of exploration without fruitful results. The present find would appear to be a suitable reward for this determined search. Other prospects in the Sturgeon River area have been rather disappointing on the whole; but it is a wide field and prospecting in it is only well started.

BRITISH COLUMBIA

• The outlook in British Columbia for increasing gold production and continued activity in searching for and developing gold prospects is auspicious. New mills are in course of erection and plans for the construction of others are steadily being advanced. Two new mills each of 100 tons' per day capacity are expected to be in operation this month, one at the Yankee Girl mine, at Ymir, and the other at the Meridian mine, in the Lardeau district. Substantial ore reserves have been developed at the former.

The mill at the Queen mine of Sheep Creek Mines is partly constructed and will be completed well in advance of sinking the new shaft and other mining developments necessary for production on a basis of 100 tons per day. The mill design and flowsheet for Ymir Consolidated Gold Mines have been prepared, and construction of a 100-ton plant will commence soon. Already the property has a mill building suitable for installation of the machinery. The situation of the mill will be such as to draw ore from the two properties controlled by the company, the old Ymir mine—a former important producer—and the Goodenough. Amalgamation followed by flotation will be used, and tests indicate that an extraction of 95 per cent and upward will be obtained.

At the Home Gold Company's property, Hope district, construction of a 25-ton pilot mill has been completed and tuning up operations have begun.

The new Hadsel mill at the Kootenay Belle mine, Nelson district, is working satisfactorily, according to reports. With the installation of two flotation cells, the mill will be stepped up to its capacity of 50 tons per day. As this is the first Hadsel mill to be installed in British Columbia, its operation is of decided interest to the industry.

Much activity prevails in the Nelson district, and gives promise at the present time of more small productive gold mines than any other district in the Province.

Passing of the boom stage in the Cariboo district, consisting mainly of claim staking and a multitude of options, followed by a quiet period last summer and fall, is to be succeeded by orderly planned development in 1935. The demonstrated profitable production from two mines—Cariboo Gold Quartz, operating a 100-ton cyanide plant, and the Island Mountain mine, controlled by the Newmont company, with a 50-ton cyanide plant—is sufficient inducement for the systematic testing out of many possibilities and potentialities in the district. The mill at the Island Mountain mine commenced operations in November and, by the end of the year, had produced bullion to the value of $55,000. This indicates that mill heads were running about one ounce of gold per ton. Work has been resumed in the driving of the crosscut tunnel at the Richfield Cariboo property. Negotiations are proceeding with English capitalists for the financing of development at the Cariboo Central, which adjoins to the south the large holdings of Cariboo Gold Quartz. Potentially, this is promising ground, covering a part of the Cow Mountain from which originated the gold that formed the rich placer deposit of Lowhee Creek. Work is also being continued on the Cariboo King Gold property, on Cow Mountain. The crosscut tunnel has been driven 400 ft., and, according to reports, Washington, D. C. interests will supply funds for further development of the property.

Bald Mountain (Cariboo) Gold Mines is proceeding with development of its property on Bald Mountain. Princess Royal Gold Mines has been reorganized, the name being changed to Surf Inlet Consolidated Gold Mines. The property consists of the old Surf Inlet and Pugsley mines and the adjoining Wells group. Development of the property and reequipment of the mill are proceeding.

On the Vidette Gold Mines, the winze on the Broken Ridge section of the property is down 120 ft., and drifts north and south have been started on the vein, which is reported to show good average width and values. A diamond drilling program has been started to explore new ground in the hanging wall in the hope of picking up the faulted section of the vein.

Ore receipts at the Trail smelter of the Consolidated company made a new high record in 1934. The total was 550,593 tons of concentrates and crude ore, of which company mines (mainly Sullivan lead and zinc concentrates) shipped 499,363 tons and customs shippers 51,229 tons. The customs shipments were nearly double those of 1933, and the total shows an increase of about 58 per cent as compared with the previous year.

B.R.X. Gold Mines is well embarked on the new development program outlined by Colonel H. H. Yuill, the company's consulting engineer. This calls for driving a 6,000-ft. tunnel to undercut six known veins at a depth 600 ft. lower than the present lowest workings on the California vein. The tunnel is in 110 ft. and is projected to cut the Arizona, Berta, Mexico, Kinder, Why Not, and California veins. The carrying out of this program will be watched with interest, as it will test out the theory held by some that better gold values will be found at depth in a higher temperature-pressure zone in this section of the Bridge River district.

NORTHWEST TERRITORIES

• Late last summer prospectors found at Beaverlodge Point, on the northeast shore of Lake Athabaska, some gold-bearing outcrops, possessing rather unusual features, that may prove to be of considerable importance. Several companies, including Consolidated Mining & Smelting, have staked claims and are preparing to investigate the area fully next season. The gold occurs in quartz in fractured zones in porphyry, near its contact with greenstone, presumably of Keewatin age. The zones appear to be from 100 to several hundred feet in width, but the average tenor of the gold remains to be determined. Beaverlodge Point is about 300 miles from the railway at McMurray to the southwest on the Athabaska River, and supplies can be readily delivered from this point by the river and lake steamers. Athabaska Lake is 120 miles long and averages about 20 miles in width, being thus much smaller than Great Bear Lake, 500 miles to the north, where navigation at times is somewhat difficult in small craft.

Work has been suspended at the White Eagle silver property, east of Great Bear Lake, as results on the second level have been disappointing.

MANITOBA

• Gods Lake Gold has opened on its first and second levels 1,200 ft. of high-grade ore. The company is preparing to construct its own power plant 30 miles to the east, and the equipment for this and the 200-ton mill are being hauled in by tractor train over the winter road. Of a number of vein systems indicated by surface work on the company's extensive holdings, only one is being developed at present.

(Continued from page 92)

nogo. The pump has a capacity of 4,000 gal. a minute. The first three days found the water lowered 154 ft. Pumping exceeded water inflow at a much faster rate than had been expected. Probably several months will be required to unwater the area, however. A second pump, of equal capacity, has been ordered and will be installed within the next two weeks.

Childress and associates are carrying on a drilling campaign while the unwatering project is being carried out. Two drill rigs are being operated, and some good holes have been reported.

The FERA has appropriated a sizable sum with which to clean out Center Creek and other branches in the Oronogo district. Otto Ruhl, a Joplin engineer, has been placed in charge of this work. The belief is that this work will eliminate much of the water that made mining in the Oronogo section so expensive before the development of the Joplin-Miami field.

When the old section is unwatered, Childress and associates probably will carry on some underground development work, and, if this proves as encouraging as the drilling campaign has up to date, a large central mill, something like that of the Central mill of Eagle-Picher Mining & Smelting, in the Picher, Okla., district, may be constructed.

At the Jan. 18 meeting of the Joplin-Miami Section of the A.I.M.E., held at Picher, Okla., discussion centered on the rock-asphalt deposits of the area. E. H. Crabtree, Jr., of Reliance Rock Asphalt, discussed the deposits in the Missouri section, and Felix Church told about the deposits in Oklahoma. M. H. Bass, engineer for the Missouri State Highway Department, discussed the construction of roadways with rock asphalt.

The sub-zero weather which struck the Tri-State field in the third week of the new year forced more than 75 per cent of the mills of the field into idleness.

MINNESOTA

• A note of optimism seems to prevail throughout the iron ranges as the new year begins. Owing to extensive steel production at the mills, the iron-ore supply is reaching a point that will necessitate increased shipments next summer to fill the stockpiles again. To care for their employees until the shipping season starts, most of the operators are either operating some underground mines, or putting through a stripping program in the open pit, or using a large crew on staggered time in repairing mine equipment.

Some of the operators are making changes in the washing plants, with expectations of more economy in the production of concentrate. At the Mesabi Chief mine of the M. A. Hanna Company the large revolving screen was discarded and replaced by a new Simons 4x12-ft. horizontal vibrating screen, the first one installed on the Mesabi range. At the Canisteo plant of Mesabi Cliffs, a 16x30-ft. Dorr washer is being removed and replaced by a 25-ft. log washer and bowl classifier to secure comparative results in determining the most economical equipment to use in ore washing. Pickands Mather are trying out a new type jig at the United States Bureau of Mines Experimental Station that may be still better than the jigs used in the past.

UTAH

• A number of new tax measures for mines are being considered by the Twentieth Utah State Legislature now in session at Salt Lake City. One of these proposes that, instead of the formula of three times the net proceeds of one year, which is now used as a basis for arriving at the assessed valuation of the ore in place for the year thereafter, the average of net proceeds for ten calendar years be used. This, it is claimed, would have the effect of making for a more constant mine tax return and would even out the peaks and dips caused by years of prosperity and of depression.

Another proposal by the State Tax Commission is that the net proceeds for a year be arrived at by taking the sum of the net proceeds for the three years immediately preceding.

The Committee of Nine, appointed by Governor Henry H. Blood to study state government, has suggested as one alternative that a combination of the net proceeds tax be combined with the severance tax, or a straight fee charged for each ton of ore mined. The severance tax is also being proposed for coal mines.

Senator George M. Miller has proposed that a jeopardy assessment be provided, so that the State Tax Commission can at anytime secure a judgment or receivership against any company apparently depleting the ore or coal reserves in such a way as to make impossible the payment of taxes.

Installation of a new hoist has been completed at the Park City Consolidated Mining property at Park City, including a new Ingersoll-Rand compressor, a new Mancha storage-battery locomotive, a new motor, ventilating fan, and additions to the cage, making it a double-deck type.

Tintic mines increased production by 60 per cent during the year 1934, to a total of 2,664 carloads, as compared with 1,606 for 1933. The increased price in silver has stimulated output and caused the reopening of a number of mines, including some of the Chief Consolidated Mining properties. The Tintic Standard led the list with a total of 1,055 carloads shipped. Chief Consolidated shipped 551 carloads, as compared with 92 in 1933.

Work has been resumed at the Wadsworth Hill Mining property, in the Alpine district, Utah County, under the direction of Phil C. Phelps, manager.

Stockholders of Old Consolidated Mercur Mining were paid a property dividend of 1c. a share recently, the first in nearly twenty years. Funds for disbursement were derived from the sale of the company's property to Lewiston-Peak Mining. Control of the company is held by George H. Dern, Secretary of War.

High-grade gold-silver ore has been opened in the Frisco Silver Lead mine, near Frisco, according to L. F. Block, manager, while excavating the foundation for a new hoist room. A crosscut extended on the 150 level to open the same fissure struck ore. A new hoist has been installed.

IDAHO

• The arrival of 1935 finds interest in new Coeur d'Alene mining developments centering to an increasing extent in the "dry-ore" silver belt in the Big Creek and Osburn sections.

Early-day shallow production from Mineral Point, Argentine, Polaris, and other claims, along with the Blake brothers' operation of the Yankee Boy holdings, the latter embraced in the present Sunshine group, consisted for the most part of relatively small tonnages of ores carrying good silver values. It has remained for a sensational demonstration by Sunshine of the great possibilities of the veins traversing this area at depth, plus temporarily adverse conditions affecting the mining of lead and zinc-bearing ores, to concentrate speculative and investment attention on this section of the district.

Sunshine passed the million dollar mark for its dividend distribution within the period of one year; enlarged its milling capacity to 750 tons daily, and established further continuity of orebodies and values to several hundred feet below the 2,100 level by diamond drilling.

Hecla Mining has undertaken development of the Polaris group, with preliminary operations by shaft extension from early-day Polaris workings. Subsequently Hecla negotiated for use of Silver Summit tunnel as an entry for main adit workings from Rosebud Gulch.

Stratton organization amalgamated the Lincoln, St. Germain, and Purim groups, with rehabilitation of the mile-long Lincoln adit tunnel to be utilized in driving an estimated 2,000 to 3,000 ft. to reach the easterly extension of the Sunshine vein system within the limits of Silver Dollar's Purim ground. With an adequate surface plant installed during the fall and all incidental preliminaries concluded, Silver Dollar's tunnel operations are advancing steadily.

• Nickel refinery of Falconbridge Nickel at Kristianssand, Norway. The stack, 400 ft. high, was erected two years ago and is the tallest in the country; the stack formerly used, dwarfed by the new one, is seen at its right. Nickel-copper matte from the Falconbridge, Canada, plant of the company is electrolytically refined here into metallic nickel and copper

Australia Extends Governmental Aid To Gold-Mining Industry

Sum of £403,000 Made Available to the Several States—Geologists to Be Appointed—Prospectors to Receive Assistance—Provision Also Made for Improvement of State-Owned Ore-Treatment Plants

GOVERNMENTS, generally, are seeing in the revival of mining their "unemployment" chance and are rendering indirect assistance to the industry in several directions. The Commonwealth Government of Australia has made available for assistance to the gold-mining industry the sum of £403,000. Expenditure of this money will be controlled by the different states. Additional geologists will be appointed to the mines departments of each State, facilities for crushing of prospectors' ore will be improved, and prospectors will be assisted in the opening up of new finds. In Tasmania, tracks will be cut in the rough country of the West Coast to facilitate mineral development.

Under a special grant of £5,000 the Commonwealth Government has made possible the establishment of three ore-dressing research laboratories. These will be situated at Melbourne University, Adelaide School of Mines, and Kalgoorlie School of Mines. Research investigators are being appointed and will commence work soon. The minergraphic work of Dr. Frank Stillwell at the Melbourne University is to be extended and his services will be in demand in connection with the investigations, which initially will be confined to gold ores. However, expectations are that base-metal ores and non-metallic minerals will be embraced later.

Unofficial estimates place the Australian gold yield for 1934 at 830,000 oz. fine, an increase of about 10,000 oz. over the figures for 1933. Many new companies will be in production in 1935, including the Lancefield, at Laverton, W. A., the Ora Banda Amalgamated, at Ora Banda, W. A., the Triton at Cue, W. A., and the Occidental and New Cobar, at Cobar, N. S. W. Increased tonnages are to be treated by Mount Morgan and Golden Plateau, in Queensland, and by Norseman Gold Mines, at Norseman, W. A. The gold yield in 1935 will certainly exceed 900,000 oz. and, perhaps, will approach 1,000,000 oz.

VICTORIA

• A dredge with a capacity of 200,000 cu.ft. monthly is to be installed by Cocks Eldorado Gold Dredging on its tin-gold alluvial area at Eldorado, Vic. The bucket band will consist of 129 10-cu.ft. manganese-steel buckets. Recovery of the gold will be effected in twelve plunger-type jigs, each with 40 sq.ft. of jigging area. The dredge will be electrically driven and will require 1,000 hp.

Subsidiary operating companies of Bendigo Mines are engaged on a comprehensive development scheme in the search for auriferous saddle reefs and spur formations. Large four-compartment shafts are being sunk, and from these shafts levels and crosscuts will provide a grid exploration system.

WESTERN AUSTRALIA

• The Western Australian Government has passed legislation making it compulsory for gold-mining companies to pay a levy of ¼d. per pound on net profit as assessed for income-tax purposes. No profits of a company may be distributed by dividends or otherwise until the levy has been paid. The government expects to receive at least £80,000 per annum from this levy, which sum will cover the expenditure of the State on miners' phthisis payments. The levy has the approval of the principal gold-mining companies.

The Big Bell mine, at Cue, has been placed under option to American Smelting & Refining, of New York. Diamond drilling has proved a low-grade formation to be 1,000 ft. long and 80 ft. wide. If a grade of 3½ dwt. per ton can be assured, the property will be equipped.

NEW SOUTH WALES

• On the New Cobar gold-copper mine, at Cobar, a flotation plant will soon be in operation. To the 520-ft. level, gold-copper ore reserves total 250,000 tons. Five winzes below this level have been in ore. Near the New Cobar is the New Occidental property, where on the No. 8 (bottom level) the lode has been proved to be 63 ft. wide The ore is less cupriferous than that of the New Cobar. The treatment plant of the New Occidental will be in commission by next June.

SOUTH AUSTRALIA

• Unwatering of the Bird in Hand gold mine, at Woodside, South Australia, is completed to the 410-ft. level, and sampling is in progress. If sampling results are satisfactory, development will be pushed ahead to prove sufficient ore to justify the erection of an ore-treatment plant. This mine, which has not been worked since 1900, is expected to become an important producer.

TASMANIA

• Provided no stoppages are caused by shortage of water, the Mount Lyell company will probably be able to operate at a profit with electrolytic copper at about £30 London, equivalent to £37 10s. in Australia currency.

PERSONAL ITEMS

H. P. Robertson is developing the Lacey gold mine, at Chester Basin, Nova Scotia, for a London group.

Dr. E. C. Turner has been elected president of the Sacramento Chapter of the Mining Association of California.

W. P. Mackle is manager of McKenzie Red Lake Gold Mines, in northwestern Ontario, at which property a 125-ton mill has recently been put in operation.

Sherman R. Burdick, former mining engineer at Miami Copper, has accepted a similar position with Mammoth-St. Anthony.

R. H. Hutchison is developing the Sturgeon River gold property, in the Nipigon district of Ontario, for Coniagas Mines.

C. G. Williams has been appointed secretary of the newly organized Canadian Metal Mining Association, with headquarters in Toronto.

Louis S. Cates, president, is visiting the Douglas, Bisbee, Ajo, Clifton, and Morenci units of Phelps Dodge Corporation.

G. G. Dobbs, who has been conducting exploration in Nova Scotia for Consolidated Goldfields of South Africa, has returned to the company's headquarters in London.

M. F. Fairlie, of Mining Corporation of Canada, has been appointed managing director of McKenzie Red Lake, in which his company holds a substantial interest.

Edwin O. Martinson, mining engineer, formerly with Tungsten Company of America, is now with Mason-Walsh-Atkinson-Kier Company, Mason City, Wash.

George M. Icard, president of the King Solomon Mining Company, returned to Baguio, P. I., in December after spending several months in the Grass Valley district in California.

T. A. Monahan has left his position on the staff of the Benguet Consolidated Mining Company to take charge of development work at the Gold Creek Mining Company.

Russell P. Patterson has accepted an appointment as an inspector of mines in Nigeria, his address being Mines Department, Jos, Nigeria, British West Africa.

Dr. W. L. Whitehead, of the Massachusetts Institute of Technology, who recently returned from mine examinations in Cuba, is visiting California and Utah.

A. Werner Lawson has become associated with Gerhard Foreman, of Chicago, in the management of his business interests. His address is Room 3220, 141 West Jackson Boulevard, Chicago.

C. H. Dickens and **W. R. May,** well-known pilots of Canadian Airways, Ltd., who have made many flights to the far mining districts of the Northwest, have been made members of the Order of the British Empire by King George.

C. M. Eye, one of the first engineers to explore the Baguio district, and the man who installed the first mill for Benguet Consolidated, returned to Baguio in December after an extended visit to the United States.

P. J. McGuire has been appointed Western Division sales manager for Oliver United Filters, Inc., succeeding **James A. Lane,** resigned. Mr. McGuire was formerly on the staff of the company's Los Angeles office.

organization in December to become consulting engineer for the Paniqui Mines, Inc., south of Manila 230 km. on the island of Luzon.

J. R. Mulryan, assistant mill superintendent and refinery superintendent at the Balatoc Mining Company, has joined the staff of the Ipo Gold Mining Company as mill superintendent. **E. C. Bitzer,** shift boss in the Balatoc mill, has taken over Mulryan's position in the Balatoc organization.

THE EXECUTIVE HEADS of the Balatoc Mining Company, at Itogon, on Batwaan Creek, Mountain Province District, Luzon, Philippine Islands, which has just become a million-peso-a-month gold producer. Left to right: George Scholey, Jr., chief engineer; G. J. Montague, mine superintendent; A. F. Duggleby, acting general superintendent; E. M. Bagley, mill superintentent; W. P. Hanley, master mechanic. H. W. Evans, general superintendent, has been ill for several months.

G. J. Montague, mine superintendent at the Balatoc Mining Company for nearly five years, will retire from active work early this year. He plans to leave Baguio with his family in March to go to the United States.

C. A. Kumke, formerly mine superintendent for Ray Consolidated, is now superintendent of Golden Queen Mining Company, Mojave, Calif., which recently purchased the Silver Queen bonanza on Soledad Mountain, described on page 89 of this issue.

Lester A. Blackner, assistant superintendent of the Arthur mill, Utah Copper Company, left Utah recently to become general manager for the Cia. Min. Aguilar, S. A., a subsidiary of the St. Joseph Lead Company, at Tres Cruces, Jujuy, Argentina.

A. A. Friedman, assistant general superintendent of the Antamok Goldfields Mining Company since 1933, left that

L. W. Buchanan, consulting engineer for the Philippines Mines Syndicate on the Narbra group of claims in Baguio during the past year, is now mill superintendent at the Gold River Mining Company. **Churchill G. Scott,** who has been in charge of development and exploration work for the Benguet-Atok Gold Syndicate, is now a mine shift boss at Gold River.

A. Chester Beatty is spending his winter vacation in Egypt. The *Daily Express* (London) pays the following tribute to him: "Chester Beatty, mining engineer, retired with a fortune made from mining science, delving into history, found the Romans mined lead in Dalmatia. Flood came. They only knew of pumps that would raise water 32 ft. They abandoned the mines. Mr. Beatty knew of pumps that would raise water thousands of feet. He took a concession and made another fortune out of scholarship."

John Carter Anderson recently examined quartz and placer mines in southwestern Oregon and northern California.

John Bryant Kasey is now metallurgist with the Hudson Smelting & Refining Company, at Newark, N. J.

Roy H. Elliott, consulting engineer, has removed his office to 1103 Hobart Building, San Francisco.

Frank C. Bowman has returned to Denver after a trip through the Black Hills of South Dakota.

George A. Sonneman has been elected chairman of the Columbia section of A.I.M.E.

R. J. Tipton, of Denver, has been elected president of the Colorado Society of Engineers.

H. B. Leggett recently assumed the post of general manager of Cia. Min. Sabina, S.A., his address being Apartado 60, Navajoa, Sonora, Mexico.

Dr. Charles Schuchert, of Yale University, was awarded the Penrose Medal of the Geological Society of America on Dec. 28.

W. H. Cropp, mill superintendent and metallurgist of Toyo Mines, Ltd., operating in Japan, is visiting Australia on leave.

W. A. Hughes, of the staff of the Broken Hill Proprietary Company, has been appointed manager of Rothsay Gold Mines, N. L., Rothsay, Western Australia.

R. J. Hylton, formerly plant superintendent of Lake View & Star, is now assistant manager of Great Boulder Proprietary, Ltd., Kalgoorlie.

V. C. Doerschuk, of Massena, N. Y., has been appointed by the Aluminum Company of America to be general superintendent of its reduction division.

Sydney H. Ball, of the firm of Rogers, Mayer & Ball, recently left New York for the West to undertake professional work.

J. H. Newby has been made president of the Oklahoma City Geological Society. **R. W. Camp** was elected vice-president and **A. J. Montgomery,** secretary-treasurer.

J. P. McFadden has been appointed superintendent in charge of mining and milling operations at the property of the Kootenay Belle Gold Mines, Ltd., in the Sheep Creek area in British Columbia.

Dr. W. B. Burnett, president of the Cariboo Gold Quartz, Ltd., was recently elected president of the British Columbia Chamber of Mines in Vancouver, B. C.

Ivan E. Goodner, general manager of the Idaho mine, in the San Juan district of Colorado, is spending several months at Washington, D. C., in connection with mining legislation.

Charles E. Prior has recently been appointed managing director of the Wiluna Gold Mines, Ltd., and consulting engineer to the Goldfields Australian Development Company, Ltd.

W. A. Waldschmidt and **E. S. Hanley,** consulting mining and geological engineers, have opened an office at 323 Colorado National Bank Building, Denver, Colo.

Ira B. Joralemon, of San Francisco, has been appointed special master for further consideration of fourteen counter claims of Consolidated Coppermines in its litigation with Nevada Consolidated.

Dr. R. W. Brock, dean of the faculty of applied science of the University of British Columbia, has been appointed by the Dominion Government to the chairmanship of the Vancouver Harbor Board.

H. R. Norsworthy, formerly with Brown, Dolbear & Norsworthy, consulting mining engineers at 17 Battery Place, New York City, has now become associated with Irving W. Bonbright at 1 Wall St.

D. H. Angus, of Haileybury, Ontario, director of Beattie Gold Mines, Ltd., and president of Guysborough Mines, Ltd., will spend the months of February, March and April at the Empress Hotel, Victoria, B. C.

Ian W. Morley has resigned from the Department of Mines, Wau, New Guinea, to join the staff of Gold Mines of Australia, Ltd., in Queensland, where a number of properties are under investigation.

Amor F. Keene left early in January for the properties of East African Goldfields, Ltd., in Tanganyika, East Africa, for which company he is consulting engineer. He will inspect the progress made by the development plant which has been shipped in this past season.

Merle H. Guise is now examining some of the old gold mines at Payson, Ariz. Last winter Mr. Guise prospected on the Yukon, where the temperature dropped to 76 degrees below zero during one snap; and during the summer he examined and opened up a gold property in the Cuyuni section of British Guiana.

Charles F. Williams, of Miami, Okla., supervising engineer of the United States Geological Survey, was elected chairman of the Joplin-Miami section of the A.I.M.E. to succeed **L. G. Johnson,** of Baxter Springs, superintendent of the Tri-State holdings of the Federal Mining & Smelting Company, at the annual election held Jan. 18 at Picher, Okla. **John R. Reigart,** of Baxter Springs, manager of the Iron Mountain Lead & Zinc Company, was elected vice-chairman to succeed **George M. Fowler,** of Joplin, and **M. D. Harbaugh,** of Miami, was reelected secretary.

J. T. Shimmin, manager of the San Juan Metals Corporation, Telluride, Colo., after closing down the San Juan Metals Mill on account of freezing weather, which ended the seasonal operations for the year 1934, left Telluride for Kellogg, Idaho, to join Frank Eichelberger's staff temporarily at the Sunshine mine, where he will have charge of metallurgical work in connection with increasing the capacity of the Sunshine mill. As soon as weather in Colorado permits, Mr. Shimmin will return to that State. The San Juan Metals Corporation operates the Gold Run placer, in Telluride, and in addition is opening up the old Treasury Tunnel mine, in the Red Mountain district near Ouray, Colo.

Julius H. Gillis has been appointed technical director of the new Electrolytic Zinc plant at Cheliabinsk, in the Urals, U.S.S.R. Construction work on this plant is nearly completed and operations will be started in the near future. Mr. Gillis has been in the Soviet Union for nearly five years and has recently been technical director of the metallurgical plant at Ordjonekedze (Oladikabkaz), in the Caucasus. This plant consists of an old lead smelter and zinc-distillation plant and a new electrolytic zinc unit and contact acid plant, which was designed, built, and operated under the supervision of Mr. Gillis. The new plant is now operating at its projected capacity. Mr. Gillis writes that there has been a decided improvement in conditions during the last year, both in the standard of living for the ordinary workers and in the ability of the various plants to fulfill their expected programs. There is also a much larger supply of articles of food and clothing in the open stores and the quality is better, but prices are still high, although in many

Cooperation Between Contributor and Editor

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cases they are less than half of what they were a year or two ago. He believes the industrial machine is at last beginning to function and expects to see its movement and efficiency accelerate rapidly from now on. His address is Anamevsky 5, Apt. 26, Moscow, U.S.S.R.

OBITUARY

William P. Morrison, mining engineer, died in Jackson, Calif., on Dec. 12; aged 44.

Frederic F. Kip, geologist and mining engineer, died at Riverside, Calif, on Dec. 19.

Dr. Wilbur Garland Forge, professor of geology at Wesleyan University, died at Middletown, Conn., on Jan. 9, at the age of 48.

Thomas S. Lewis, chief residential engineer at East Geduld Mines, Springs, mining district of Johannesburg, South Africa, died recently, aged 65.

Dr. Herdman Fitzgerald Cleland, professor of geology and mineralogy at Williams College, died at sea in the wrecking of the Mohawk on Jan. 24.

William Wisner White, a mining attorney, poet, artist, and humanitarian, long identified with shippers of ore on the Great Lakes, died on Jan. 6 at Cleveland, Ohio. He was 68 years old.

R. H. Humphrey, prominent placer mining engineer of San Francisco, was killed in an automobile accident near Wells, Nev., late in December. Mr. Humphrey was 53 years old. He was a member of the A.I.M.E. and the Engineers Club of San Francisco.

Roland W. Wood, president of Premier Gold Mining Company, in the Salmon River district of British Columbia, died recently at Vancouver, B. C.; aged 64. He had been prominently identified with gold and silver mining in the West and in Canada for many years.

E. H. Leslie, district manager of *Coal Age* and *Engineering and Mining Journal,* Chicago, and affectionately known as "Gene" to hundreds of mining men and manufacturers of mining equipment in the Middle West and Rocky Mountain States, died suddenly at his home in Wilmette, Ill., on Jan. 14, from an attack of pneumonia. Mr. Leslie was a member of the A.I.M.E., the University Club (Chicago), and the Columbia and Princeton Alumni associations. He is survived by a widow and three children.

Thomas L. Philipps, 64, the miner who probably did more to make the Baguio district one of the most flourishing in the world than any other man, died Dec. 14 in Manila. "Tom" Philipps, as he was known to the mining fraternity, came to the islands in 1908 to become mine foreman at the Headwaters Mine, now the Baguio Gold Mining Company. He left that plant to work on the Muyot properties for a short time, and then joined the Acupan Mining Company, in 1918. He stayed with that concern until Benguet Consolidated took it over in 1927. For several years

Tom Phillips
Old-timer in the Baguio District, Philippines

he was one of the directors of the newly formed Balatoc Mining Company, and had a considerable interest in the company at the time of his death. From the first visit he made to the Acupan mine, he declared that it was one of the world's best, and although several mining engineers scoffed at his faith in the property, he stuck to his opinion and later had the satisfaction of seeing it become one of the richest ever worked. Of him old mining men in the Baguio region declare: "Tom Philipps had no enemies. If a vote were to be taken on the most honest, dependable, and likeable men in the district, he would be Number One." He originally came from New South Wales, Australia, where his only relatives are. He was buried in Baguio after his body had laid in state in the Army Morgue in Manila.

Walter E. Holt died in Austin, Tex., on Jan. 15. He took an active part in mining at Magdalena, Sonora, Mexico, from 1905 to 1915. Later, he made his headquarters at Nogales, Ariz., and worked mines in that region. Mr. Holt was of pioneer stock; his family having migrated from Harrison, Ark., to a point near Alma, N. M., during 1879, where his father, Isham R. Holt, engaged in the cattle business for a number of years. He was graduated from the State College, New Mexico, in 1899.

Mining Industry's Apathy Toward Federal Aid

The Editor:

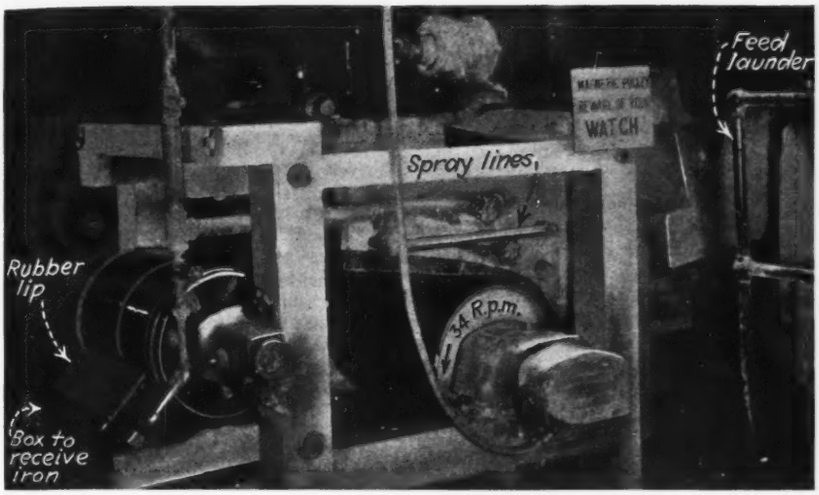
The cause of the apathy of the mining industry toward the proposed loans by the RFC, to which attention is drawn in your editorial in the December issue of *Engineering and Mining Journal,* is not far to seek. Briefly, it can be attributed to the following condition: Those operators and aggregations of capital owning or operating mines that could qualify for a mining loan under the conditions embodied in the loan application neither require nor desire a loan. Other mine operators, either as individuals or in groups, who have mining property of merit, and would be glad to avail themselves of a loan, have not the slightest chance to qualify for the same under the terms and conditions laid down. The latter class, or the larger part of them, are operating with small amounts of money contributed from time to time as their ability permits. They naturally prefer to see the money that would be required to comply with the requirements of the RFC's application go into active work on their properties rather than expend the same in making application for a loan which they feel assured they would not get. Any funds expended by the miners or mine operators in this class to make an application to the RFC for a loan would be like buying a ticket in the Irish Sweepstakes, with the chances in favor of the sweepstakes.

From a strictly conservative banking standpoint no fault can be found with the requirements of the RFC in connection with these loans if they are going to be made on a positively secure basis to aid mining or any other industry. But why set up a department under government sanction to aid the mining industry that has suffered badly for lack of the necessary funds to carry on, and then inject requirements and conditions that virtually prohibit any approach to its assumed objective?

By these remarks I am not inferring that loans should be made by the federal Government through the RFC, or any other agency, to mining or any other industry. It is my opinion that far greater assistance could be rendered to the mining industry by enlarged and adequate financial support of the Bureau of Mines, the U.S.G.S. and State mining bureaus, which are strictly and properly governmental agencies that could develop valuable and timely data for the use of those actively engaged in the mining industry. They could also render a service to the investing public if inquiries were answered as to any particular district, or mines and prospects within the same. These departments are now supposed to be functioning and collecting such data and information, but the appropriations, both state and federal, for the support and operation of these departments is so small, that only a very meagre amount of information and data are now available compared with the amount that should be available and which could be collected. Even the maps of the U.S.G.S. are from ten to fifteen years behind the industry, which in many districts is itself far from up to date. In view of these conditions it might be in order to suggest that the idea of "loans to aid mining" be abandoned, and that substantial appropriations be made to the mining bureaus, both state and federal, and the U.S.G.S., all of which agencies have seasoned organizations.

A. G. KIRBY.
San Andreas, Calif.

EQUIPMENT NEWS



Removing Process Iron From a Grinding Circuit

Wright-Hargreaves Finds Magnetic Pulley Effective At Its Cyanide Plant

Wright-Hargreaves Mines, Ltd., at Kirkland Lake, Ont., is using a magnetic pulley for removing process iron from the grinding circuit in its cyanide plant. The deleterious effects of process iron in grinding circuits have been emphasized by various technical writers. In the installation cited, the pulp impinges upon an inclined belt which runs over the magnetic pulley. This belt is of the vanner type and confines the splashing to a minimum. Special non-corrosive metals are used on the pulley's outside surface. The pulley must be absolutely watertight. This is achieved by the use of special glands at the shaft and along the periphery where the non-magnetic head, which is of special alloy steel, engages the outer flanges of the magnetic pulley proper. The collector rings are housed to protect them from rust and other corrosion. The pulley was supplied by Dings Magnetic Separator Company, Milwaukee.

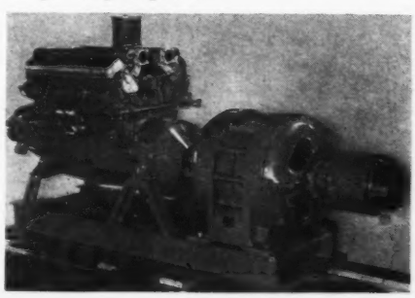
According to H. Vincent Walace, chief metallurgist and research engineer for Wright-Hargreaves, the steel and iron pulled out of the discharge of two tube mills, each of which was grinding about 200 tons, has amounted to as much as 6 tons of steel per 24 hr., this during the first few days in which the installation was in service. At the end of four weeks the extraction was about 1,600 lb. per 24 hr. So confident was he that this would help in the grinding as well as in the extraction of gold in the cyanide circuit, that Mr. Wallace decided to duplicate the magnetic pulley, stipulating, however, that the end hubs should be made of stainless steel.

This Rig Speeds Drilling In Open Pits

Although not especially designed for mining work, the new WD wagon drill, recently developed by the Cleveland Rock Drill Company, Cleveland, Ohio, will be found applicable in open-pit work. An accompanying cut shows one in the field. The rig will drill holes to any depth possible with drill steel in any direction around a 360-deg. circle. The holes can be drilled, moreover, at any angle above or below the horizontal. Feed is automatic and can be regulated for fastest work under all conditions. Economy in air consumption is claimed by the manufacturer. Fewer bits are said to be used, because the steels are held in line and continuously at the correct distance from the rock face. This results in less wear on the gage and on the cutting edges. No separate hoist is required for the drill, nor is blocking needed to set up on sloping ground. Efficient control valves are provided for feed, hammer drill, and blowing, arranged within convenient reach. Any hole can be blown clean. Steel is kept in line when starting a hole by means of a two-piece centralizer, the wings of which stay open or closed without any auxiliary device. The boom can be raised or lowered by one man. Equipped with a D12 drifter, the rig ranges in weight from 1,680 to 1,820 lb.

New Diesel Weighs 12½ Lb. Per Horsepower

One of the cuts on this page shows a 200-hp. full diesel engine which weighs only 2,500 lb., or 12½ lb. per horsepower. This has been developed by the Hill Diesel Engine Company, of Lansing, Mich. The heaviest part of it weighs only 300 lb., so that it can be disassembled and taken into remote places by mule-back, if necessary. The engine shown in the illustration is mounted on the same shaft as a 100-kw. generator set, which weighs only 6,000 lb. Together the two units constitute a heavy-duty, dependable power plant. One like that shown in the cut was recently delivered to the Agua Fria mine, in Honduras. By a coincidence, a short article describing the work that is being done at the mine mentioned appears in this issue on page 69. All equipment was taken into the plant by airplane.



Stripper Capacity Increased

A new stripping shovel, with dippers up to 22 cu.yd. and a working weight of 2,400,000 lb., has been announced by Bucyrus-Erie Company. Unusual in output capacity and working ranges, this

unit, Model 950-B, is readily convertible for shovel or dragline operation, and has the fastest digging cycle yet offered in machines of its class. It may be had with booms up to 110 ft. in length, with dipper handles up to 70 ft. long, and dippers of 14 to 22 cu.yd. capacities—as may be required to suit the open-pit conditions.

Individual motors on each of the four caterpillar units give variable speeds for turning, which is further simplified by hydraulic steering, minimizing the slewing of units and skidding of belts. Output time is saved by use of hydraulic leveling while the machine is digging. The front end is immensely strong, yet unhampered by unnecessary weight. Added steadiness is given the dipper by twin, single-part hoists. Power peaks are reduced by use of a counterbalanced hoist.

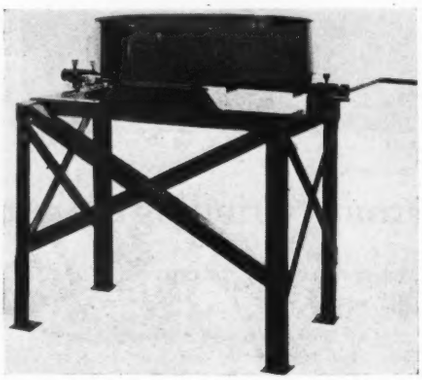
A Simple Vacuum Filter for the Small Mill

Especially Useful for Clarifying Gold Solutions And Cyaniding High-Grade Materials

The needs of the small mill for filtering concentrates and other products are met in a new vacuum filter known as the Bee-Tee tilting filter, which has been developed by the Booth-Thompson Division of the Galigher Company, Salt Lake City, Utah. This filter is said to fill a gap in filtration equipment and to be adequate for small tonnages. The small mill operator no longer needs to use makeshift methods in filtering. In principle, the new filter operates under ideal conditions. It is built in three sizes; namely, 3-, 4- and 5-ft. diameters, giving from 7 to 15 sq.ft. of filtering surface, and capable of filtering from 1 ton to 8 tons of flotation concentrates per 8 hr.

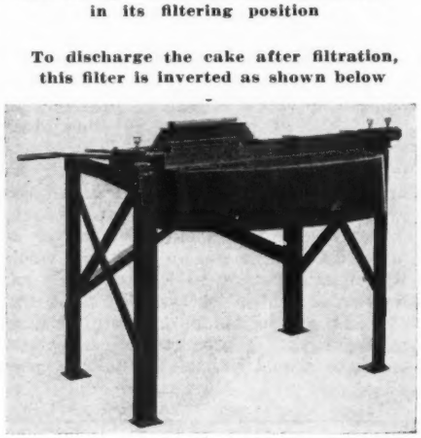
In construction, as shown in the two accompanying cuts, the apparatus consists of a vacuum pan which has a suitable canvas filtering medium at the bottom. The pan is attached to a shaft at the bottom, one side of the shaft being hollow and connected to a suitable valve on the framework. The material to be filtered is conducted to the pan, the filtrate passing through the vacuum line until the required reduction in moisture is obtained. The pan is then inverted by means of a lever which automatically closes the vacuum valve port and opens the air pressure blow-back port, freeing the filter cake from the filter.

This filter is thought by the manufacturer to be ideal also for use as a sand filter for clarifying cyanide gold solutions, as well as for cyaniding high-grade products, inasmuch as it allows any number of periodic washes before discharging a particular batch of material.



The tilting filter with the vacuum pan in its filtering position

To discharge the cake after filtration, this filter is inverted as shown below



The X-Ray and Sound Castings

Several months ago, a 400,000-volt X-ray installation was placed in operation at the Chicago Heights (Illinois) foundry of the American Manganese Steel Company. This is being used for testing pilot castings of given lots, as well as large and expensive parts. Enough castings are so treated to insure that the company's manganese-steel and chromium-nickel alloy products will be sounder and more economical than ever before.

With the X-ray, the experienced radiographer can, so to speak, "see into" the casting (to the depth of 5 in. of metal) and feel sure that all defects within the area photographed, whether shrinks, spongy metal, blowholes, internal cracks, or inclusions, will show up clearly. It is possible, when the defect is known, to revise the design or method of manufacture so that commercially sound castings can be produced continuously.

This Vibrating Screen Built For Minimum Repair Cost

Their experience in developing and manufacturing vibrating screens indicated to the engineers of the Smith Engineering Works, Milwaukee, Wis., that the principal difficulties encountered were those that arose in the course of maintenance work. They therefore centered on the problem of building a vibrator that could be repaired in the least possible time and with inexpensive labor. The Telsmith Pulsator, which resulted from this conception, is a heavy-duty screen, specially designed for both dry and wet screening of sand, gravel, crushed rock, ore, and coal. Its frame is of great strength and carries the entire weight of the vibrating unit and the dependent screen decks. Frame members are securely welded and reinforced by heavy angles. The frame is horizontal and consequently more compact, rigid, and more conveniently installed. When supported from below, special rubber pads may be had to reduce vibration. If suspended by cable, springs can be used for the same purpose.

The screen decks are actuated by means of a vibrating unit, being suspended from a shaft by means of a bearing unit, which consists of two eccentric housings welded to a large steel pipe. In these heavy steel shells, protected by both labyrinth and piston ring seals, are housed the cylindrical roller bearings which are the heart of the apparatus. The inner races are bored eccentrically and keyed to the shaft by the same keys which hold the flywheels. Thus, there is no wear on the shaft itself. Instead, this is entirely on the races in both journals.

The eccentric action produces a circular movement which causes the aggregate to dance over the wire. This movement promotes maximum screening action and is uniform on all parts of the deck and equally effective on every deck. The pulsation is constant under all loads.

Novel Air Tool Effective For Tightening Nuts

By means of a small machine, weighing only about 20 tons, nuts 1 in. or larger in size can be spun down at 700 r.p.m., and then given a series of smart torsional blows at the rate of 1,400 a minute to tighten them as securely as desired. This novel pneumatic tool is the Pott impact wrench, recently introduced by Ingersoll-Rand Company, New York. A principle entirely new to the pneumatic tool field has been brought into play; namely, that of the rubber "accumulator." This is a cylindrical block of special rubber interposed between the "Multi-vane" air motor and the chuck. In operation, the torque from the motor is applied to the accumulator, which in twisting becomes shortened, lifting the "hammer" from engagement with the "anvil." The hammer is then released and spun forward to the next engagement, thus delivering a powerful blow with considerable mass behind it, to the anvil, on the end of which the chuck is attached. These torsional impacts occurring at the rate of 1,200 to 1,400 per minute exert a more powerful turning effect than is possible with any other portable wrench. The wrench is operated by one man.

New Explosive Requires Dynamite For Detonating It

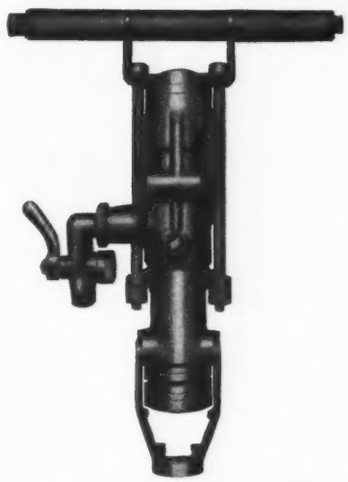
A revolutionary new blasting material for use in quarries and in other blasting operations such as stripping has been announced by the du Pont company, at Wilmington, Del. This new product cannot be detonated by the strongest commercial blasting cap, by impact, by flame, nor by shooting a rifle bullet into it. In actual use it is exploded by means of a large-diameter cartridge of dynamite. It is non-headache producing and is rendered absolutely water resistant by being sealed up tightly in a tin can. It represents the ultimate in safety so far as a blasting agent is concerned. This new development represents a radical departure in the explosives field and has been covered by two patents, one for the product and the other for the method of using it. It is non-freezing. It will be known as "Nitramon." The new product will be marketed only in large diameters, for example, 4, 4½, 5 and 7 in. It is adapted solely for use in large diameters and has been designed specifically to fulfil as nearly as possible the ideal qualifications for use in quarries.

Important Advance Achieved In D.C. Transmission

A complete new system for the transmission and distribution of electric power, making it possible for the first time to interconnect, with static apparatus, non-synchronous systems, has been developed by General Electric Company. This has been done by the utilization of electronic devices, including Thyratron and Phanotron tubes. With the new system a higher order of stability has been obtained as contrasted with previous practice, and faults similar to short circuits result in a reduced instead of an increased power flow on the circuit involved. The new system, constant-current direct-current transmission, was described in a paper presented at the winter convention of the American Institute of Electrical Engineers, in New York City in January, by Dr. C. H. Willis, B. D. Bedford, and Dr. F. R. Elder. Dr. Willis is of Princeton University, and the other two are with General Electric.

Excessive Manifolding Eliminated In New Compressors

In the design of the new two-stage, belt-driven, stationary compressors, developed by Schramm, Inc., West Chester, Pa., in a range of sizes from 105 to 420 cu.ft. of free air per minute capacity, few connections are required. In consequence, fewer air pockets, twists, and turns for the air flow are produced, the air is cooler, and less power is required to deliver a cubic foot of actual air through the tank. Between the first and second stages a one-piece cross-flow intercooler is used, which reduces the air temperature more than 85 per cent between stages. It also serves as a filter for the air between the stages. This simplified method of passing air through head stages and intercooler is said to eliminate excess of manifolding, with its attendant leakage.



A Light Sinker for Spots Where Weight Handicaps

Owing to its light weight, a new 28-lb. sinking drill (S-35), developed by the Gardner-Denver Company, Quincy, Ill., is said to be exceptionally easy to handle in places inaccessible to a heavier drill, and is suited for drilling in soft and medium formations, as well as for plugging in quarries or on construction jobs. It is also adaptable to numerous uses around industrial plants. It has a full-grip D handle, a short-throw totally enclosed tubular valve, one-piece exhaust-control valve and handle, and a simple, sturdy steel puller. The air inlet is conveniently placed and there are no side-rod springs.

INDUSTRIAL NOTES

Lima Locomotive Works, Inc., Lima, Ohio, has changed the name of the Ohio Power Shovel Company, its subsidiary, to Lima Locomotive Works, Inc., Shovel and Crane Division.

Eimco Corporation is the new corporate name of the Eastern Iron & Metal Company, of Salt Lake City, Utah.

M. A. Eiben, president of Northern Blower Company, Cleveland, Ohio, recently made an extensive trip through Mexico, where he visited Monterrey, Mexico City, Fresnillo, Torreon, and Pachuca, stopping at mines and smelters on his route. His company will install a complete dust-collecting system for the new crushing plant which the Fresnillo company is building.

Logan Engineering Company, Chicago, Ill., announces that the hoist-controller business which has been managed for sixteen years by H. H. Logan through the Duro Metal Products Company has grown so as to necessitate forming a company to specialize in Lilly and Simplex hoist controllers, Logan hoist recorders, and similar specialties. This is the Logan Engineering Company, Inc., H. H. Logan, president and general manager. Oscar H. Lilliedahl, formerly with the Nordberg Manufacturing Company, is first vice-president and chief engineer.

Cochise Rock Drill Manufacturing Company, subsidiary of the Independent Pneumatic Tool Company, Chicago, is now in charge of A. H. Skaer. Mr. Skaer was formerly associated with the Denver Rock Drill Manufacturing Company and was long its president.

Allis-Chalmers Manufacturing Company recently played host at "open house" at its plant at West Allis, Wis., to a crowd estimated at more than 30,000. Chief attractions were the huge hydraulic turbines for Boulder Dam. Hundreds of other products turned out by the eight major departments of the company were exhibited. From the smallest Texrope drive weighing a fraction of a pound to the huge 860-ton steam turbine for Port Washington, Wis., the company displayed its line, which plays a part in the industrial working of almost every industry.

BULLETINS

Mining, Quarry and Gravel Pit Machinery. Smith Engineering Works, Milwaukee, Wis. Bulletin 266J, covering Telsmith screens, log and trommel washers, elevators, conveyors, and related equipment. Pp. 31.

DuPrene Synthetic Rubber. E. I. du Pont de Nemours & Co., Wilmington, Del., Rubber Chemicals Division. Booklet entitled "A Story of Man-made Rubber." Pp. 12.

Griffin Jet'n Drive Wellpoint. Griffin Wellpoint Corp., 60 East 42d St., New York. For penetrating gravel and other hard subsoils. Pp. 4.

Dark Field Optical Systems. Bausch & Lomb Optical Co., Rochester, N. Y. Pp. 16.

Aftercoolers for Air or Gas. Ingersoll-Rand Co., New York. Bulletin 9212. Pp. 12.

Industrial Rubber Goods, Engineering Data. B. F. Goodrich Rubber Co., Mechanical Division, Akron, Ohio. A guide to the selection of belting, hose and other products. Pp. 23.

Boiler Feed Control. Northern Equipment Co., Erie, Pa. Illustrated paper by E. G. Grady, plant engineer, on "Operating Experience at Masonite with High-Pressure Boiler Feed Control." Folder No. 137. Pp. 4.

Midget 5-in-1 Slide Rule. Tavella Sales Co., 25 W. Broadway, New York. Folder.

Two-stage Air-cooled Portable Compressors and Pneumatic Tools. Ingersoll-Rand Co., New York. Pp. 56.

Magnetic Pulleys and Pulley-type Separators. Dings Magnetic Separator Co., Milwaukee, Wis. Catalog No. 25. Pp. 24.

Drill Steel Shop Equipment. Worthington Pump & Machinery Corp. Harrison, N. J. Bulletin W1200-B10. P. 12.

Bench Drill. Champion Blower & Forge Co., Lancaster, Pa. New catalog covering this and other new products including a new floor drill; also backward curve steel plate fans for general heating and ventilating.

Flotation Reagents. Hercules Powder Co., Wilmington, Del. Leaflet.

Rock Drill Steel. Swedish Steel Mills A. A., Chrysler Bldg., New York. A handbook by Lennart Nordenfelt, mining and metallurgical engineer at the company's Fagersta Steel Works in Sweden. Pp. 143. Published by Brukskoncernen A. B., Fagersta, Sweden.

Flotation Process. Hercules Powder Co., Wilmington, Del. A descriptive bulletin containing flotation circuit formulae and other data. Pp. 31.

Outdoor Group-operated Horn-gap Switch. General Electric Co., Schenectady, N. Y. Bulletin GEA-2023. Pp. 2.

Merrill-Crowe Simultaneous Clarification Precipitation Process. The Merrill Co., 343 Sansome St., San Francisco, Calif. A folder.

Vibrating Screens. Robins Conveying Belt Co., New York. Bulletin 93. Vibrex screens. Pp. 4.

Gyratory Crushers. Traylor Engineering & Manufacturing Co., Allentown, Pa. Circular No. 95, entitled "For Worthwhile Efficiency, Bell-shaped Crushing Heads Must Be Used With Curved Concaves." Pp. 4. Copy on request.

SUMMARY OF

MONTHLY COMMENT . . . DAILY AND AVERAGE MONTHLY

BUSINESS indicators all point to a substantial increase in general industrial activity for the month of January, but, so far as new buying of major non-ferrous metals was concerned, manufacturers must be using up material purchased some time ago. Copper sales in the domestic market for January totaled 27,000 tons, against 19,500 tons in December and 15,300 tons in November. In view of the slim buying in the last two months of 1934, the gain in business fell short of expectations. Both lead and zinc sales were considerably under those reported for copper.

The trend of prices, disregarding domestic copper and tin, was slightly downward. Our index of non-ferrous metal prices for the month of January was 70.43, against 71.13 in December, and 67.32 in January, 1934.

Uncertainty over the gold-clause case before the Supreme Court retarded buying toward the close of the month. In spite of the cloud that the delay in rendering a decision has cast over business, gold and silver prices suffered little. Gold in London, in terms of the pound, moved up from 140s. 10½d. at the beginning of the month to 142s. 1d. at the close. The United States Government was a purchaser of silver abroad on a fairly extensive scale.

Various informal meetings in reference to the international copper rationalization plan were held during the month. Owing to the many complications that still stand in the way before a general meeting can be called, hopes for quick results have virtually been abandoned. Most producers in touch with the situation are of the opinion that an agreement of some sort, aimed at regulating the market, will eventually be reached. All concerned, it is said, have something to gain by controlling production. The foreign price of copper lost about 30 points during the month, partly the result of forced liquidation in London of a large speculative account.

Primary producers of copper in the United States agreed on Jan. 22 to waive their sales quotas for the fourth consecutive time since the middle of last September, extending the period to March 31.

Refined lead stocks in the United States increased to 235,457 tons at the end of 1934. Stocks at the end of November were estimated at 232,934 tons, and in December, 1933, the surplus amounted to 203,061 tons. Buying of lead during January was disappointing, which finally caused the market to weaken.

United States Market

Jan.	Electrolytic Copper: Domestic (a)	Electrolytic Copper: Domestic (b)	Electrolytic Copper: Export (c)	Straits Tin: New York	Lead: New York	Lead: St. Louis	Zinc: St. Louis
1				Holiday			
2	9.00	8.775	6.700	50.750	3.70	3.55	3.725
3	9.00	8.775	6.750	50.650	3.70	3.55	3.725
4	9.00	8.775	6.750	50.700	3.70	3.55	3.725@3.750
5	9.00	8.775	6.775	50.700	3.70	3.55	3.725@3.750
7	9.00	8.775	6.775	50.625	3.70	3.55	3.750
8	9.00	8.775	6.725	50.900	3.70	3.55	3.750
9	9.00	8.775	6.675	51.250	3.70	3.55	3.750
10	9.00	8.775	6.650	51.150	3.70	3.55	3.750
11	9.00	8.775	6.650	51.100	3.70	3.55	3.750
12	9.00	8.775	6.625	51.100	3.70	3.55	3.750
14	9.00	8.775	6.600	50.650	3.70	3.55	3.750
15	9.00	8.775	6.525	50.500	3.70	3.55	3.750
16	9.00	8.775	6.500	50.750	3.70	3.55	3.750
17	9.00	8.775	6.500	50.850	3.70	3.55	3.750
18	9.00	8.775	6.525	51.000	3.70	3.55	3.750
19	9.00	8.775	6.575	51.100	3.70	3.55	3.750
21	9.00	8.775	6.600	51.150	3.70	3.55	3.750
22	9.00	8.775	6.550	51.000	3.70	3.55	3.700@3.725
23	9.00	8.775	6.500	51.100	3.70	3.55	3.700
24	9.00	8.775	6.475	51.150	3.70	3.55	3.700
25	9.00	8.775	6.475	50.950	3.70	3.55	3.700
26	9.00	8.775	6.500	50.950	3.70	3.55	3.700
28	9.00	8.775	6.475	50.750	3.70	3.55	3.700
29	9.00	8.775	6.450	50.950	3.70	3.55	3.700
30	9.00	8.775	6.425	50.950	3.60	3.45	3.700
31	9.00	8.775	6.400	51.100	3.60	3.45	3.700
Av. for month		8.775	6.583	50.916	3.692	3.542	3.730
				Averages for Week			
2		8.775	6.700	50.760	3.70	3.55	3.723
9		8.775	6.742	50.804	3.70	3.55	3.742
16		8.775	6.592	50.875	3.70	3.55	3.750
23		8.775	6.542	51.033	3.70	3.55	3.735
30		8.775	6.467	50.950	3.683	3.533	3.700
				Calendar Week Averages			
5		8.775	6.735	50.720	3.70	3.55	3.730
12		8.775	6.683	51.021	3.70	3.55	3.750
19		8.775	6.538	50.808	3.70	3.55	3.750
26		8.775	6.517	51.050	3.70	3.55	3.710

Silver, Gold, and Sterling Exchange New York and London

Jan.	Sterling Exchange: "Checks"	Sterling Exchange: "90-day" Demand"	Silver (d): New York	Silver (d): London	Gold: London	Gold (e): United States
1			Holiday			
2	4.93875	4.94000	55.0000	24.6250	140s10½d	$35.00
3	4.93000	4.93125	54.8750	24.6250	141s 6½d	35.00
4	4.91750	4.91875	54.8750	24.6875	142s 1 d	35.00
5	4.92000	4.92125	54.8750	24.6875	141s 7½d	35.00
7	4.91125	4.91250	54.6250	24.5625	142s 1 d	35.00
8	4.90625	4.90750	54.2500	24.3125	142s	35.00
9	4.92250	4.92375	54.6250	24.5625	141s11 d	35.00
10	4.91750	4.91875	54.6250	24.5625	141s 4½d	35.00
11	4.91250	4.91375	54.3750	24.4375	141s 9½d	35.00
12	4.90500	4.90625	54.2500	24.4375	141s 7½d	35.00
14	4.89625	4.89750	54.2500	24.5000	141s11 d	35.00
15	4.86750	4.86875	54.2500	24.5625	142s 4 d	35.00
16	4.87625	4.87750	54.2500	24.5625	141s 6 d	35.00
17	4.88000	4.88125	54.2500	24.6250	141s11 d	35.00
18	4.88000	4.88125	54.2500	24.5625	142s 1½d	35.00
19	4.88000	4.88125	54.2500	24.5625	142s	35.00
21	4.87500	4.87625	54.3750	24.6250	142s ½d	35.00
22	4.88125	4.88125	54.3750	24.6250	142s 1 d	35.00
23	4.88625	4.88625	54.3750	24.6250	142s 1½d	35.00
24	4.88500	4.88500	54.3750	24.6250	141s 4 d	35.00
25	4.87625	4.87625	54.3750	24.6250	141s 4½d	35.00
26	4.86000	4.86000	54.2500	24.6875	141s 8 d	35.00
28	4.85750	4.85625	54.3750	24.7500	141s 6 d	35.00
29	4.87125	4.87000	54.5000	24.7500	141s 8½d	35.00
30	4.87000	4.86875	54.1250	24.5625	142s 1 d	35.00
31	4.87000	4.86750	53.8750	24.4375	142s 1 d	35.00
Av. for month	4.89207	.....	54.418	24.584	.....	35.00
			Averages for Week			
2	4.93750	.....	54.550	.....	.....	.....
9	4.91792	.....	54.688	.....	.....	.....
16	4.89583	.....	54.333	.....	.....	.....
23	4.88042	.....	54.313	.....	.....	.....
30	4.87000	.....	54.333	.....	.....	.....

Calendar week averages: New York Silver Jan. 5th, 54.875; 12th, 54.458; 19th, 54.250; 26th, 54.354.

(a) Quotation issued by the Code Authority for copper offered for sale in the domestic market pursuant to the provisions of the Copper Code.

(b) Net prices at refineries on the Atlantic seaboard, being Code Authority prices, less delivery and interest charges of 0.225c. per lb. which is the average differential for delivery in New England.

(c) Export quotations for copper are net prices at refineries on the Atlantic seaboard and include sales of domestic copper in the foreign market. The c.i.f. Hamburg, Havre, and Liverpool basis commands a premium of 0.300c. per lb. above our f.o.b. refinery quotation.

Excepting "Blue Eagle" copper, the above quotations are our appraisal of the major United States markets, based on sales reported by producers and agencies. All prices are in cents per pound.

Copper, lead and zinc quotations are based on sales for both prompt and future deliveries; tin quotations are for prompt delivery only.

Quotations for copper are for the ordinary forms of wirebars and ingot bars; cathodes discount of 0.125c.

Quotations for zinc are for ordinary Prime Western brands. Zinc in New York is quoted at 0.35c. per pound above St. Louis, this being the freight differential. Contract prices for High-Grade zinc delivered in the East and Middle West in nearly all instances command a premium of 1c. per pound over the current market for Prime Western but not less than the *E. & M. J.* average for Prime Western for the previous month.

Quotations for lead reflect prices obtained for common lead, and do not include grades on which a premium is asked.

(d) Silver other than newly mined domestic. Under Executive order issued Dec. 21, 1933, the U. S. Government price on newly mined domestic silver was established at 64½c. per troy ounce.

(e) U. S. Treasury's gold price.

THE MARKETS

PRICES OF METALS . . . MISCELLANEOUS QUOTATIONS

London Market

Jan.	Copper Standard Spot	Copper Standard 3M	Copper Electrolytic Bid	Tin Spot	Tin 3M	Lead Spot	Lead 3M	Zinc Spot	Zinc 3M
1					Holiday				
2	28.3125	28.7500	31.5000	228.3750	228.2500	10.2500	10.5625	12.0000	12.3125
3	28.4375	28.8750	31.7500	228.3750	228.2500	10.2500	10.5625	11.9375	12.2500
4	28.6875	29.1250	32.0000	228.6250	228.3750	10.3125	10.6250	12.0625	12.3750
7	28.7500	29.1875	32.1250	228.7500	228.2500	10.1875	10.5000	12.0000	12.3125
8	28.6250	29.0625	31.7500	230.8750	228.5000	10.1875	10.5000	11.8750	12.2500
9	28.4375	28.8125	31.5000	232.0000	229.1250	10.1875	10.5000	11.8750	12.1875
10	28.1875	28.5625	31.5000	232.7500	229.1250	10.2500	10.5625	11.8750	12.2500
11	28.2500	28.6250	31.6250	231.0000	229.2500	10.3125	10.6250	12.0000	12.2500
14	28.0625	28.5000	31.2500	230.5000	228.7500	10.2500	10.5000	12.0000	12.2500
15	27.9375	28.3750	31.0000	230.6250	228.8750	10.2500	10.5000	12.0000	12.3125
16	27.8125	28.1875	31.0000	230.2500	228.7500	10.1875	10.4375	11.8750	12.1875
17	27.6875	28.0625	31.0000	230.7500	228.7500	10.2500	10.5000	11.9375	12.2500
18	28.1250	28.5000	31.5000	231.0000	228.7500	10.2500	10.5000	11.9375	12.2500
21	28.3125	28.6250	31.5000	232.6250	228.8750	10.5000	10.6250	12.0000	12.2500
22	28.1875	28.4375	31.2500	232.2500	228.8750	10.4375	10.5625	11.9375	12.1875
23	28.0625	28.3125	31.0000	232.3750	228.8750	10.4375	10.5625	11.9375	12.1250
24	27.6250	27.9375	30.7500	232.5000	228.8750	10.4375	10.4375	11.9375	12.1250
25	28.0000	28.2500	31.0000	232.0000	228.8750	10.4375	10.5000	12.0625	12.1875
28	27.8750	28.1875	31.0000	231.7500	228.8750	10.3750	10.4375	12.1875	12.1875
29	27.5000	27.8750	30.7500	232.3750	228.8750	10.4375	10.5000	12.1875	12.0625
30	27.2500	27.5625	30.2500	232.7500	228.8750	10.4375	10.4375	12.1250	12.0000
31	27.5625	27.8750	30.7500	233.7500	228.8750	10.4375	10.3750	12.1250	12.0000
Av. for month	28.077	.....	31.261	231.193	.....	10.321	10.514	11.994	12.207

Current Prices—Miscellaneous Metals, Ores, and Non-Metallic Minerals

Quotations cover wholesale lots, prompt shipment, f.o.b. New York, unless otherwise stated.

(Feb. 1, 1935)

Miscellaneous Metals

Aluminum, ingot, 99 per cent plus, lb.	(a) 19@21c.
Antimony, domestic or Chinese (duty paid), lb.	14½c.
Bismuth, ton lots, lb.	$1.10
Cadmium, lb.	55.00c.
Chromium, 97 per cent grade, lb.	88.00c
Nickel, electrolytic cathodes, lb	35.00c.
Magnesium, 99.8 per cent, carloads, lb.	30.00c.
Palladium, troy oz.	$24.00
Platinum, (official quotation) troy oz.	$34.00
Quicksilver, flask of 76 lb.	$72.50@$73.00
Radium, mg. radium content	$50.00
Selenium, 99.5 per cent, lb.	$2.00
Silicon, minimum 97 per cent, spot, lb.	16.50c.
Tellurium, lb.	$2.00
Thallium, 100 lb. or more, lb.	$6.50
Titanium, 96 to 98 per cent, lb.	$6.00
Zirconium, commercially pure, lb.	$7.00

Metallic Ores

Beryllium Ore, f.o.b. mines, ton	$30.00@$35.00
Chrome Ore, 45@47 per cent, c.i.f., long ton	$16.00@$16.50
Iron Ore, Lake Superior, long ton:	
Old Range bessemer	$4.80
Mesabi, bessemer	$4.65
Old Range, non-bessemer	$4.65
Mesabi, non-bessemer	$4.50
Lead (Galena) 80 per cent, Joplin, Mo., ton	$32.00
Manganese Ore, long ton unit:	
52@55 per cent	26c.
49@51 per cent	25c.
44@47 per cent	24c.
Molybdenum Ore, per lb. of contained MoS_2	42c.
Tungsten Ore, per unit of WO_3:	
Chinese, duty paid	$16.50@$17
Domestic Scheelite	$16.50
Vanadium Ore, per lb. of contained V_2O_5	27½c.
Zinc Ore, Prime, 60 per cent concentrate, Joplin, Mo.; per ton.	$26.00

Metallic Compounds

Arsenious Oxide (arsenic) lb.	3½c.
Cobalt Oxide, 70@71 per cent, lb.	$1.35
Copper Sulphate, 100 lb.	$3.85
Sodium Nitrate, ex vessel, in 200-lb. bags, per 100 lb.	$1.24
Sodium Sulphate, bulk ton	$13.00@$15.00

Alloys

Beryllium-Copper, Master alloy, 3.5 per cent Be, per lb. of contained Be	$25.00
Ferrochrome, 65@70 per cent chromium, 4@6 per cent carbon, lb.	10c.
Ferromanganese, 78@82 per cent, gross ton	$85.00
Ferromolybdenum, 50@60 per cent Mo, lb. of Mo contained	95c.
Ferrosilicon, 50 per cent, gross ton	$77.50
Ferrotungsten, 75@80 per cent, lb. of W contained	$1.35@$1.45

(a) Our basis for quoting on aluminum has been revised, effective Jan. 2, 1935. Current quotation based on open-market transactions on competitive business.

Non-Metallic Minerals

Asbestos, f.o.b. mines, ton:	
Canadian (Quebec)	
Crude No. 1	$500@.....
Crude No. 2	$200@$225
Spinning fibers	$90@$135
Paper stock	$32.50@$37.50
Shorts	$11@$14.50
Vermont	
Shingle stock	$45@.....
Paper stock	$35@.....
Cement stock	$23@.....
Barytes, long ton:	
Georgia, crude	$7@.....
Missouri, 95 per cent $BaSO_4$, 1 per cent iron	$5@.....
Bauxite, long ton:	
Domestic, chemical, 55@58 per cent	$6@ $7.50
Domestic, abrasive, 78@84 per cent	$12.50@$15.00
Dalmatian, 50@55 per cent	(a) $4.50@ $6.00
French, 56@59 per cent	(a) $5.50@ $6.50
China Clay, f.o.b. mines, ton:	
South Carolina and Georgia, bulk	$6.00@ $7.50
Delaware, No. 1	$14.00@.....
Feldspar, bulk, ton:	
Potash feldspar, 200 mesh	$17.00
Glass-spar, white, 20 mesh	$11.50
Fluorspar, f.o.b. mines, bulk, Kentucky and Illinois 85-5 per cent, all rail movement, ton	$13.50
Fuller's earth, f.o.b. Georgia or Florida, ton	$7.00@$14.00
Magnesite, per ton:	
Dead-burned, f.o.b. California	$25.00@.....
Dead-burned, f.o.b. Washington	$22.00@.....
Mica, per lb., North Carolina, No. 1 and 2 quality:	
1½x2 in.	15@30c.
2x2 in.	30@50c.
2x3 in.	50@65c.
3x4 in.	90@ $1.25
4x6 in.	$1.50@ $2.50
White, ground, 70 mesh, ton	$60.00@$80.00
Ocher, Georgia, ton	$19.00@$22.50
Pyrites, Spanish, per long ton unit of S, c.i.f. Atlantic ports	(a) 12@ 12½c.
Silica, water-floated, in bags, 325 mesh, ton	$16.00@$40.00
Sulphur, Texas mines, long ton	$18.00@.....
Talc, f.o.b. works, ton:	
New York, double air-floated, 325 mesh	$12.00@$15.00
New Jersey, mineral pulp	$8.00@$10.00
Vermont, extra white, 200 mesh	$8.50@ $9.00
Tripoli, Missouri, ton:	
40 mesh, cream colored	$16.00@.....
200 mesh, cream colored	$26.00@.....

(a) Nominal.

Iron and Steel

Pig Iron, Valley furnaces, gross ton:	
Bessemer	$19.00
Basic	$18.00
No. 2 Foundry	$18.50
Steel, base prices, Pittsburgh:	
Billets gross ton	$27.00
Structural shapes, 100 lb.	$1.80
Bars, 100 lb.	$1.80

MONTHLY AND YEARLY AVERAGE PRICES

Silver and Sterling Exchange

	New York		London Spot		Sterling Exchange	
	1934	1935	1934	1935	1934	1935
January	44.188	54.418	19.382	24.584	504.644	489.207
February	45.233	.....	20.073	.....	503.085	.....
March	45.875	.....	20.278	.....	509.259	.....
April	45.180	.....	19.740	.....	515.210	.....
May	44.226	.....	19.276	.....	510.510	.....
June	45.173	.....	19.981	.....	504.721	.....
July	46.310	.....	20.512	.....	503.990	.....
August	48.986	.....	21.377	.....	506.398	.....
September	49.484	.....	21.888	.....	499.344	.....
October	52.375	.....	23.581	.....	494.019	.....
November	54.255	.....	24.257	.....	498.832	.....
December	54.390	.....	24.404	.....	494.520	.....
Year	47.973	.....	21.229	.....	503.711	.....

New York quotations for silver not eligible for sale to U. S. Government, cents per ounce troy, 999 fine. London, pence per ounce sterling silver 925 fine. Sterling exchange in cents.

Copper

	F.O.B. Refinery			London Spot			
	Electrolytic			Standard		(a) Electrolytic	
	Domestic		Export				
	1934	1935	1935	1934	1935	1934	1935
January	7.890	8.775	6.583	32.560	28.077	35.614	31.261
February	7.777	.....	.....	33.072	.....	35.969	.....
March	7.775	.....	.....	32.497	.....	35.512	.....
April	8.173	.....	.....	33.006	.....	36.038	.....
May	8.275	.....	.....	32.662	.....	35.756	.....
June	8.594	.....	.....	32.149	.....	35.339	.....
July	8.775	.....	.....	29.707	.....	32.778	.....
August	8.775	.....	.....	28.358	.....	31.483	.....
September	8.775	.....	.....	27.541	.....	30.556	.....
October	8.775	.....	.....	26.753	.....	29.478	.....
November	8.775	.....	.....	27.233	.....	30.222	.....
December	8.775	.....	.....	27.836	.....	31.086	.....
Year	8.428	.....	.....	30.281	.....	33.319	.....

New York quotations, cents per pound. London, pounds sterling per long ton. (a) Bid quotation.

Lead

	New York		St. Louis		London			
	1934	1935	1934	1935	1934 Spot	1934 3 Mos.	1935 Spot	1935 3 Mos.
January	4.000	3.692	3.900	3.542	11.304	11.517	10.321	10.514
February	4.000	.....	3.900	.....	11.634	11.913	.....	.....
March	4.000	.....	3.900	.....	11.545	11.842	.....	.....
April	4.179	.....	4.042	.....	11.500	11.794	.....	.....
May	4.140	.....	3.990	.....	11.051	11.341	.....	.....
June	3.975	.....	3.825	.....	11.054	11.253	.....	.....
July	3.772	.....	3.623	.....	10.813	11.045	.....	.....
August	3.747	.....	3.597	.....	10.821	11.028	.....	.....
September	3.685	.....	3.535	.....	10.388	10.613	.....	.....
October	3.654	.....	3.504	.....	10.359	10.554	.....	.....
November	3.567	.....	3.417	.....	10.432	10.597	.....	.....
December	3.604	.....	3.454	.....	10.316	10.500	.....	.....
Year	3.860	.....	3.724	.....	10.935	11.166	.....	.....

New York and St. Louis quotations, cents per pound. London, pounds sterling per long ton.

Tin

	Straits New York		Standard, Spot London	
	1934	1935	1934	1935
January	51.891	50.916	226.631	231.193
February	51.668	.....	226.731	.....
March	53.838	.....	233.863	.....
April	55.622	.....	239.181	.....
May	53.541	.....	234.239	.....
June	51.271	.....	226.875	.....
July	51.930	.....	230.381	.....
August	51.953	.....	228.114	.....
September	51.503	.....	229.888	.....
October	50.951	.....	230.587	.....
November	51.227	.....	228.602	.....
December	50.902	.....	228.178	.....
Year	52.191	.....	230.273	.....

New York quotations, cents per pound. London, pounds sterling per long ton.

Zinc

	St. Louis		London			
	1934	1935	1934 Spot	1934 3 Mos.	1935 Spot	1935 3 Mos.
January	4.271	3.730	14.688	14.943	11.994	12.207
February	4.384	.....	14.844	15.125	.....	.....
March	4.368	.....	14.735	15.033	.....	.....
April	4.370	.....	14.916	15.200	.....	.....
May	4.346	.....	14.722	14.966	.....	.....
June	4.240	.....	14.241	14.467	.....	.....
July	4.317	.....	13.466	13.693	.....	.....
August	4.281	.....	13.682	13.756	.....	.....
September	4.049	.....	12.644	12.847	.....	.....
October	3.832	.....	12.217	12.353	.....	.....
November	3.732	.....	12.000	12.281	.....	.....
December	3.711	.....	11.730	12.016	.....	.....
Year	4.158	.....	13.657	13.890	.....	.....

St. Louis quotations, cents per pound. London, pounds sterling per long ton.

Cadmium and Aluminum

	Cadmium		Aluminum	
	1934	1935	(a) 1934	(b) 1935
January	55.000	55.000	23.300	20.000
February	55.000	.....	23.300	.....
March	55.000	.....	23.300	.....
April	55.000	.....	23.300	.....
May	55.000	.....	23.300	.....
June	55.000	.....	23.300	.....
July	55.000	.....	23.300	.....
August	55.000	.....	23.300	.....
September	55.000	.....	23.300	.....
October	55.000	.....	23.300	.....
November	55.000	.....	23.300	.....
December	55.000	.....	23.300	.....
Year	55.000	.....	23.300	.....

Aluminum in cents per pound, 99 per cent grade. (a) Based on Aluminum Company's quotation. (b) Open market price.
Cadmium, cents per pound.

Antimony, Quicksilver, and Platinum

	Antimony (a) New York		Quicksilver (b) New York		Platinum (c) New York	
	1934	1935	1934	1935	1934	1935
January	7.198	14.111	67.538	72.760	38.000	34.000
February	7.172	.....	72.011	.....	38.000	.....
March	7.545	.....	75.472	.....	38.000	.....
April	7.918	.....	75.930	.....	38.000	.....
May	8.465	.....	75.577	.....	36.538	.....
June	7.900	.....	75.000	.....	36.000	.....
July	8.024	.....	75.000	.....	36.000	.....
August	8.514	.....	75.000	.....	36.000	.....
September	8.745	.....	74.563	.....	36.000	.....
October	9.361	.....	74.000	.....	35.038	.....
November	12.239	.....	73.283	.....	35.000	.....
December	13.730	.....	73.000	.....	35.000	.....
Year	8.901	.....	73.865	.....	36.465	.....

(a) Antimony quotations in cents per pound, for ordinary brands. (b) Quicksilver in dollars per flask of 76 lb. (c) Platinum in dollars per ounce troy.

Pig Iron

	Bessemer		Basic		No. 2 Foundry	
	1934	1935	1934	1935	1934	1935
January	18.00	19.00	17.00	18.00	17.50	18.50
February	18.00	.....	17.00	.....	17.50	.....
March	18.00	.....	17.00	.....	17.50	.....
April	18.48	.....	17.48	.....	17.98	.....
May	19.00	.....	18.00	.....	18.50	.....
June	19.00	.....	18.00	.....	18.50	.....
July	19.00	.....	18.00	.....	19.50	.....
August	19.00	.....	18.00	.....	18.50	.....
September	19.00	.....	18.00	.....	18.50	.....
October	19.00	.....	18.00	.....	18.50	.....
November	19.00	.....	18.00	.....	18.50	.....
December	19.00	.....	18.00	.....	18.50	.....
Year	18.707	.....	17.707	.....	18.207	.....

Iron in dollars per long ton. F.o.b. Mahoning and Shenango Valley furnaces.

H. C. PARMELEE
Editorial Director

Engineering and Mining Journal

A. W. FISHER
Manager

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WILLARD CHEVALIER
Vice-President

TENNESSEE VALLEY AUTHORITY is one alphabetical agency of the Government that is trying to keep Uncle Sam out of competition with private industry. Following its decision to buy instead of making cement for TVA dams, it reversed its earlier policy on fertilizers and decided to sell none in the open market—unless Congress compels. Fertilizers now being made experimentally will be used by other Government agencies on prevention of soil erosion and similar projects of national importance.

•

"THE MINING JOURNAL," of London, our highly respected and esteemed contemporary, will celebrate in 1935 the hundredth anniversary of its founding. Only a publisher can fully appreciate what it means for a journal to live an entire century and still be in its prime. Congratulations to *The Mining Journal*.

•

MINING IN MEXICO presents problems that were unknown to the operator of twenty years ago. The Government—federal and state—is a factor that must be reckoned with in several ways. New policies are being adopted to assure to the nation a larger share in the benefits of its mining industry. An article expressing the views of various high officials and written by one who is well acquainted with the country will be published soon.

•

GOLD IN SEA WATER varies in quantity from place to place, the range being from one part in ten million to ten parts per million, or from one-tenth milligram to ten milligrams per liter. Several views have been held as to the mode of occurrence, some believing that the gold exists in the colloidal form or as chloride. The most acceptable theory, however, is that the metal is ionized—a charged atom or an electron.

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TIN, to the producer and trader, spells Banka, Bolivia, the Malay Peninsula, Nigeria, and London, to say nothing of an interesting and at present effective scheme for controlling its output. The latter, however, is only one phase of a discussion of the situation of the metal which is to be presented in an early issue. So far as the United States is concerned, tin is a strategic metal.

•

TEXTILES serve the metallurgist well; also at times displace one another. A certain smelter uses 2,800 18 in. by 30 ft. woolen bags. Two other baghouses, at a zinc oxide plant, formerly had each 2,000 woolen flumes, of somewhat larger size. Recent developments have caused one to substitute asbestos for the wool and the other to change to cotton. Filter cloth, blankets, corduroy also have their part.

•

GWYNFYNYDD AND TYDDYNGLADYS are expected to add to the gold output of Great Britain, now that they have been leased to a London company for exploitation. These Welsh mines have already increased the picturesqueness of the long list of odd and interesting names of properties that confront the reader of current mining news. Which brings to mind that two poor-house inmates in Ohio, former drillers, brought in a 30-bbl. oil well in the infirmary yard the other day and promptly organized the Pauper Oil Company.

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A CURIOUS and uncommon form of magnesium aluminum silicate has the appearance and feel of thick white leather and is often spoken of as mountain leather. It is composed of very short fibres of mineral, which make the substance quite flexible. This and other leathery forms of fibrous silicates are sometimes loosely termed asbestos.

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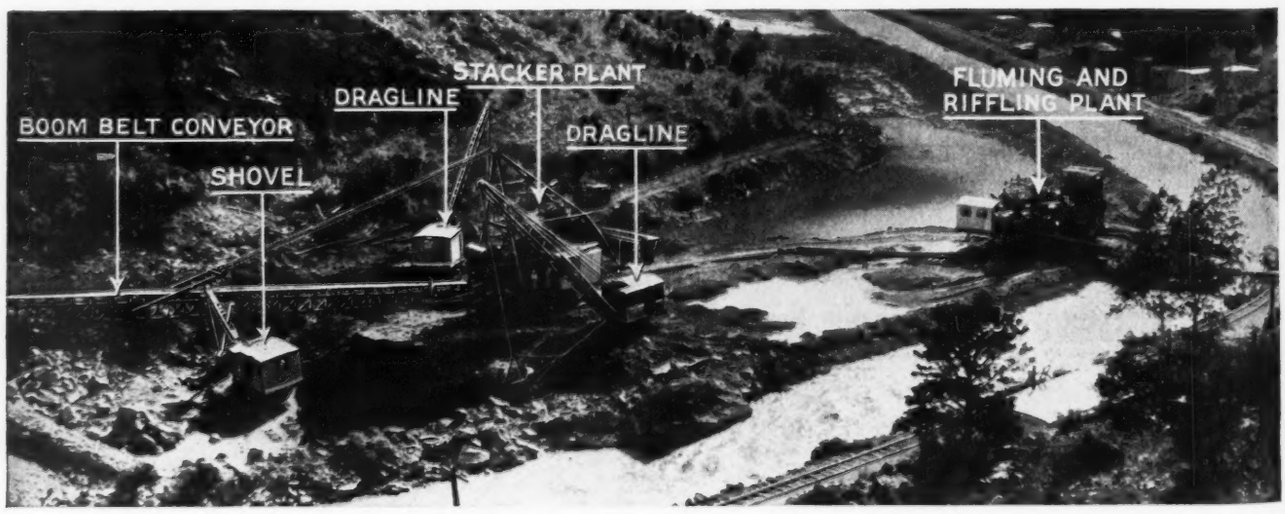

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